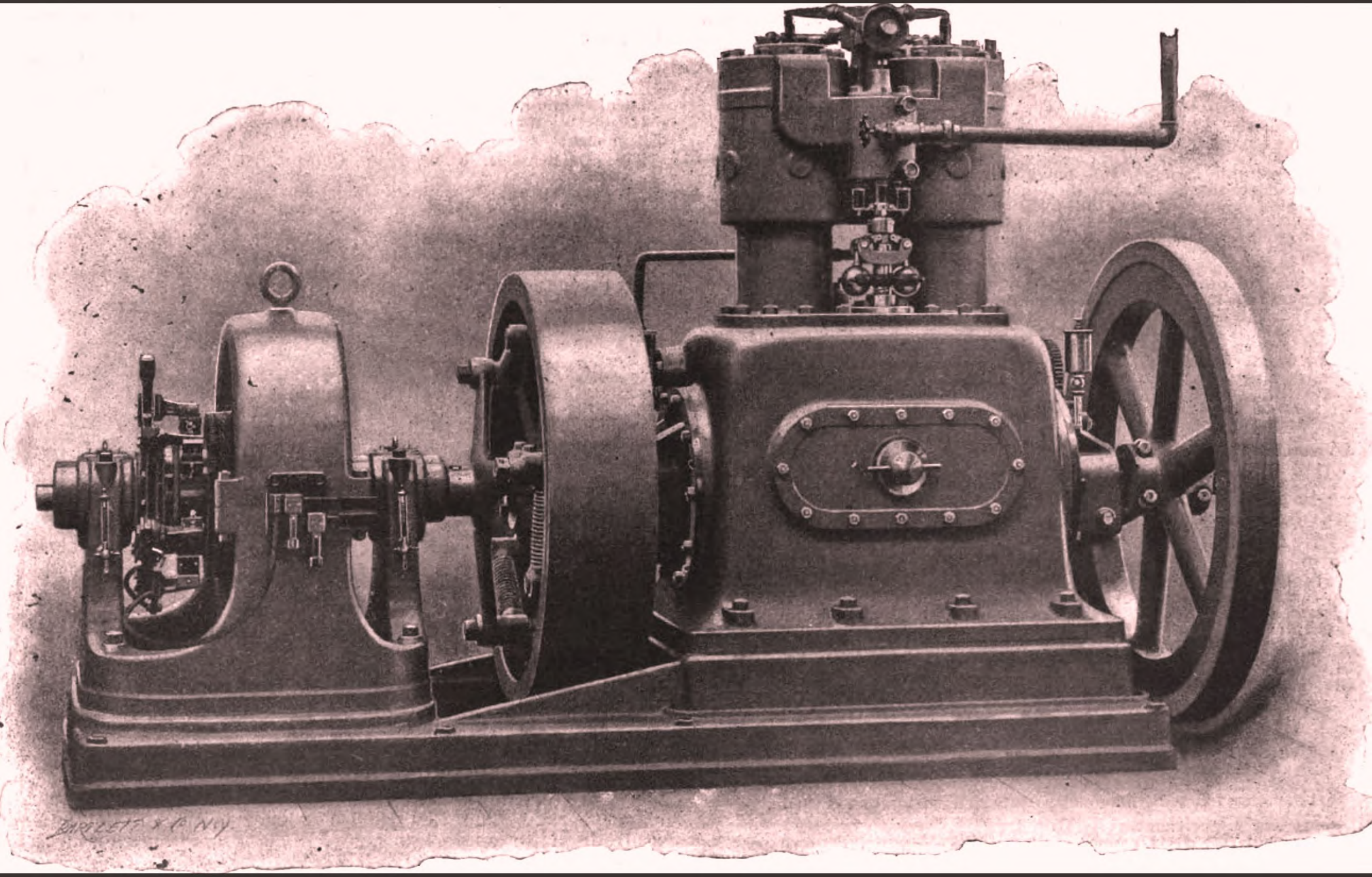

Electrical engineer


VASSOS

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TELEPHONY AND TELEGRAPHY

AUTOMATIC TELEGRAPHY.—III.

BY P. B. DELANY.

(Concluded.)

THE new system embodies many improvements without which practical use would be greatly hampered. Heretofore the chemical solution was applied to the tape by drawing it from one reel to another through the liquid. Now the tape comes in loosely wound rolls from the factory. They are dropped into the solution bodily. After a few hours' saturation the rolls become solid by absorption of the fluid. Kept in stoneware or dark glass jars with lids, the tape will remain in good condition for several weeks. It is ready for use twelve hours after soaking. The margin of moisture is very wide, as may be seen from the long time it remains in condition. It is less trouble to handle than perfectly dry tape, but, as a matter of fact, it is not handled at all after having been placed on the horizontal reel of the receiver. It is automatically reeled up after passing under the recording wires. One message or twenty may be received at a time.

The spool containing the tape being removable, it is taken to the translator who may use a typewriter or write it out in manuscript. The spool is placed on a spindle to the right of the table, the end of the tape is placed between the pulling rollers of a simple clockwork at the left side of the table, leaving 2½ feet of the tape in plain view of the translator. When this is read, by touching an auxiliary key on the typewriting machine or table, the pulling machine instantly draws another definite length of tape in view. Thus the tape is not handled. No time is lost in shifting copy, and the translator always knows where to begin. Typewritten translation can be made from these plain and unmistakable signals with the same facility and accuracy as from print. An ordinary speed for a translator would be 35 to 40 words per minute, or about twice the speed reached when receiving by sound from the average Morse sending.

A perforating operator will easily equal the Morse operators sending speed, while the typewriter will translate from the tape twice as fast as the sound receiver who is held down to the speed of the sender. In this way there would be a saving of one operator out of three, but even though the receivers in both cases were put on an equality, in what respect does the operation of the automatic system differ essentially from quadruplex Morse? The quadruplex has one actual wire and three "phantom" circuits. Reckoning a perforator and typewriter as being equal to a sending and receiving operator, or a Morse circuit, the automatic system would have one wire and fifty to one hundred phantom circuits, according to distances. No. 1 perforator would work with No. 1 typewriter at the other end. The number of the typewriter for whom the received tape was intended would be the first signal on the tape. Any corrections or other necessary inquiry relating to the business handled by these two people would be exchanged between them alone. Those unaccustomed to it have an exaggerated idea of the difficulties of handling business by automatic, not appreciating the fact that a million words of press news is sometimes handled in a night in the London Main Office in this way.

It is a curious fact that the main objection advanced against the new system is that it is too fast, and would require too many hands to keep it busy. The question is asked, Where could sufficient traffic be found to keep it going? The elastic capacity of the system will, of course, adapt it to any condition, and its excessive efficiency will find employment as soon as the tolls are reduced. The remaining objections raised against the new system are carried over from the old state of the art, viz.: "Nothing to detect an interruption to the circuit during transmission;" and, "Nothing to show when the message is finished," etc. It has been explained and demonstrated on several occasions within the past year that these difficulties have been overcome, and much else besides.

The reel holding the chemical tape is set in motion automatically before any tension is applied to the tape by the drawing rollers, so that it never breaks, and the start is made at full speed. When the sending tape has run through the transmitter the receiving tape is instantly stopped, also automatically, and at the same time a brake is put on the tape reel to prevent accumulation of slack. Not an inch of tape nor an instant of time is wasted. The machine tender knows that when the tape stops transmission is ended. A tell-tale sounder constantly chattering instantly indicates any interruption to the work, and if necessary the machine tender at the receiving end can by pressing a key stop the transmitter instantly at any stage, and upon giving the last word recorded, the transmitter tender pulls back the tape to that word and transmission is resumed. In other words, the receiving operator can "break" the sender as in ordinary Morse. After receiving the signal to start, the transmitting operator has full control over the receiving instrument, starting it simultaneously with the transmitter.

In view of this explanation it is to be hoped that those opposed to machine telegraphy per se will give up going down among the dead men for material upon which to base their objections to a perfectly worked out system of automatic telegraphy of the present day. A great deal of rubbish has been put forth of late on this subject, recounting the faults of a quarter of a century ago and studiously evading acknowledgment of well proven remedies for them all.

This system will transmit and record perfectly legible signals (which any one can translate after a week's practice) at any speed that may be required up to 3,000 words per minute, according to the line employed. It will carry 1,000 words per minute 1,000 miles over a one ohm per mile wire.

To disparage high speed telegraphy the companies take the ground that with their present slow methods of operating they have ample wire facilities for all the business offered. Of this there can be no doubt, but it is folly to argue that, with a system which will increase the capacity of a wire twenty to thirty times over the quadruplex, thereby warranting a reduction of rates to about one-quarter of the present tolls, would not increase the business to an extraordinary degree.

In the United States the average number of letters per head per annum is 36; postal cards, 7; telegrams, about 1, and the average cost of a telegram is 30 cents for ten words. If fifty words can be sent for 15 cents, surely a large proportion of the communications now sent by mail will be telegraphed—leaving the present companies all the business they are now doing. An automatic system using the magnificent postoffice system of collection and delivery, and practically eliminating the railway time, would attract a large portion of the correspondence now going by train, amounting to about seventy million dollars per year, especially between points widely separated, such as New York and Chicago, and all cities beyond.

If it pays to erect and maintain two copper wires 1,000 miles for 60 words conversation per minute, it ought to be profitable to put the same amount of copper in one wire and record 1,000 words per minute, and if the 300 words resulting from a five-minutes' talk at a cost of nine dollars between New York and Chicago can be delivered typewritten for 90 cents, it is reasonable to expect that there will be a field for the new system.

It is thought that in this country at least the time is near at hand when all cities of 25,000 inhabitants and upward will be connected up by large copper conductors, few in number but great in carrying capacity, and that all correspondence of any urgency will be carried by them. The old cries of induction, static capacity, etc., have lost their significance.

When it is proposed to lay down an Atlantic cable having in its initial construction ample compensation for all these obstacles, it seems absurd to say that a bare copper wire on poles accessible at every foot cannot be balanced so as to carry signals at the highest rate of its conductivity.

Comparisons made from the most careful study of the subject show that by the new automatic system one wire is made equal to 100 Morse circuits simplex, 50 duplexes, 25 quadruplexes, or seven Wheatstone duplexes, and that by reason of its simplicity it is adaptable to almost every class of traffic. Five or six drop copies of press matter can be made without serious detriment to through working, or the same tape can be used any number of times on different circuits for news distribution. Traffic can be exchanged with any number of stations on a way wire in rotation from a central or terminal point. Repeaters will not be necessary even on the longest circuits, for the slowest speed working through will exceed the highest reliable repeater working.

An Atlantic cable nearly 2,000 miles in length having 650 pounds of copper per mile is operated at 50 words per minute with 40 volts. A wire of 850 pounds of copper per mile be-

tween New York and San Francisco, 3,500 miles, with about one-eighth the total electrostatic capacity, should yield at least 250 words a minute by the automatic system, using 300 volts, and having recourse to all the compensating expedients well understood in modern telegraphy.

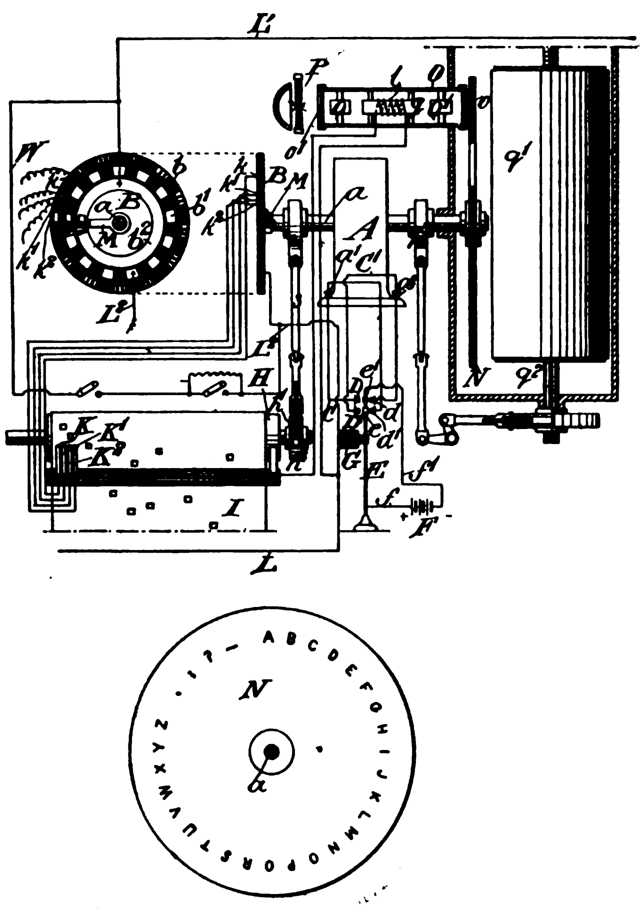
South Orange, N. J.

THE EATON PHOTOGRAPHIC PRINTING TELEGRAPH.

BY C. F. EATON, JR.

THE chief desideratum for a telegraph instrument is that it shall secure the transmission and receiving of ordinary messages, provide for express service and the transmission of a larger amount of intelligence automatically at a high rate of speed which shall entail the least amount of time and labor, with a simplicity of construction that will enable its easy use by any practical telegraph operator.

It is evident that this instrument must be of the printing class if the labor and time of receiving and translating are to be much lessened. Heretofore the main faults of this class of instruments has been their lack of speed for automatic work and their complexity, involving as it does a special training of the operator. This lack of speed in printing instruments is largely due to the fact that in all of them the printing mechanism has to be stopped for an instant for each character transmitted.



EATON PHOTOGRAPHIC PRINTING TELEGRAPH.

The following is a description of an automatic instrument in which the printing is done by the aid of light and instantaneous photography, obtaining thereby, it is claimed, a speed equal to the chemical telegraph in actual transmission over the line besides having all the advantages in speed and otherwise of the printing telegraph and is believed by the writer to meet all the requirements above stated.

The following is a description of the apparatus and its methods of operation: A represents an alternating current motor, a its armature shaft, in axial alignment with a commutator, B. The arm E serves as a pole-changer by making contact alternately with the two sets of contact pieces under the influence of an electro magnet, G, toward and away from the core of which the positive pole of the arm, E, is drawn and driven as the magnet, G, receives the alternating pulsations from the line-wire with which it has a shunt connection, as will be described later. The roller, H, is adapted to receive the perforated pattern strip, I, and cause it to pass step by step in engagement with a series of electric conducting brushes, $K\ K'\ K^2$, etc., one for each character within the scope of the instrument. These brushes, when opposite a perforation in the strip I, make electric contact with the roller, H, and through it with the line-wire, L, coming, as shown, from the left to the instrument, and including at the station here illustrated a helix, l, for operating a shutter.

The commutator, B, consists of three concentric rings $b\ b'\ b^2$, insulated from one another and the whole fixed relatively to the motor shaft, a, with which the commutator is in alinement. The outer ring, b, has alternate spaces of contact and insulation of equal length, the middle ring, b', similar alternating spaces of contact and insulation, but arranged to alternate radially with the spaces on the outer ring, viz., to bring an insulation-space on the middle ring radially opposite a contact space on the outer ring—and the inner ring, b^2, has a continuous annular contact surface.

The contact spaces on the outer ring, b, are provided with groups of contact points, $k\ k'\ k^2$, one for each character within the scope of the instrument and each electrically connected with its coresponding brush, $K\ K'\ K^2$. A trailer, M, carried by the motor shaft, a, is so located as to sweep the faces of the three rings, $b\ b'\ b^2$, with each revolution of the shaft, a, and in so doing make electric contact between each of the points, $k\ k'\ k^2$, etc., and the contact face of the inner ring, which is in permanent connection with the outgoing main-line wire, L', at the right, as shown. As the trailer passes over the alternate insulation spaces on the outer ring it will make electric connection between the contact spaces on the middle ring, b', and the inner ring, and hence will electrically connect the outgoing wire, L', with the shunt-wire, L^2, which connects the middle ring, b', with the incoming main-line wire and includes the magnet, G. The alternate contact and insulation spaces on the commutator are made to correspond to the pulsations of the alternating current, the positive pulsations being received through the outer ring, inner ring, and main line, L', to operate the shutter at a receiving station, and the negative pulsations being returned through the line-wire, L', inner ring, b^2, middle ring, b' magnet, G, and line-wire, L, to the origin of the main line current.

As the positive pulsation passes along the main-line wire it will render the magnet, G, neutral with respect to the positive pole of the arm, E, and it will swing into contact with the pieces, d d', causing the current from the battery, F, to pass through the magnet of the motor, A, and when the negative pulsation passes along the main-line wire it will cause the magnet, G, to attract the arm, E, and hence draw it into contact with the pieces, D D', and hence cause the current from the battery, F, to pass in the opposite direction through the magnet of the motor, A.

The roller, H, with its mechanical pattern, the commutator, B, and the motor, A, constitute the important elements of the sending division of the instrument or apparatus.

The receiving division of the apparatus includes also the motor, A, and in addition thereto a disc, N, having in an annular series the several characters included within the scope of the instrument and mounted to rotate with the shaft, a, the motor to present the several characters during each revolution of the shaft in alinement with an opening in the end, o, of the opaque tubular casing, O. An opening in the opposite end, o', of the tubular casing admits light from a suitable source.

The casing, O, with its polariscope and helix, l, constitutes an electrically operated shutter for disclosing the particular character at the receiving station which may be selected by the commutator at the sending station, the movement of the disc, N, being made to harmonize with the movement of the commutator at the sending station to present that particular character opposite the shutter which corresponds to the contact point, $k\ k'\ k^2$, etc., on the commutator which is at that moment connected by the trailer with the inner ring, b^2, and hence with the main-line wire, L'.

The disclosed character at the receiving station may either be observed directly by the eye of the person receiving or the character may be photographed upon a sensitized film, q', in a dark chamber, q^2, the film being made to move step by step by means of a pawl and ratchet by the motor, A.

A TELEPHONE MAN'S TROUBLE.

The manager of a telephone exchange has many amusing and at the same time exasperating experiences during the discharge of his duties. Almost every day he is called upon by some subscriber, who reports that his telephone is out of whack, and then the manager or one of the telephone company's employés starts out looking for trouble. He doesn't

wear brass knuckles or carry a revolver, but he begins at the exchange and follows the wire along which the difficulty is supposed to exist, picking out his way through alleys, backyards, climbing fences and telegraph poles in his endeavor to find the trouble. After hours of time, the telephone man finds that the difficulty is in the subscriber's 'phone, and this, perhaps, caused by a thoughtless or careless act of some person. Manager Middleton, of the Merchants' Mutual Company, says that he has many times been called upon to locate trouble in some telephone, only to find that a hatpin, a watch, button hook, nail or some other metallic article had been carelessly placed on top of the telephone in such a manner as to connect the little nickel-plated posts and cut off the circuit, thus destroying the connection of the telephone with the exchange. Several instances of this kind have lately occurred and much trouble and delay resulted, which could easily have been prevented had the actions of metallic bodies coming in contact with two electrical poles, been understood or a little forethought used by telephone subscribers.—Michigan News.

PRIVATE TELEPHONE CONSTRUCTION.—I.

BY F. H. SMITH.

THE early private telephone outfits were made by beginners, installed by beginners, and cared for by beginners. As a person looks closely into the private telephone business at the present time, he can see plainly the results of the work of the amateur. It is time to call a halt, to cause the "genius" as he calls himself, to get conversant with the work so that he can do it properly. At a rapid pace some of the most expensive buildings in the country are getting cobwebbed. In some cases the wires are bundled in cables and the large cables run on hard finished ceilings; these ceilings were designed to be ever kept clear from such obstacles, so that they can be kept clean and free from vermin.

The contractor should go to work rightly and tell those for whom the work is to be done, that it costs money to do good work, show them how it should be done and tell them the reasons why. Any sane person will be convinced that he don't want loose, dirty wires on the floors or walls of a building if the thing is properly presented in the start. Most people like to see the wires at first and think they are a sort of an indication of some wonderful pieces of skill and work, but this notion wears off after a time and in most cases they have the work done over.

If the telephones are going into a wooden building arrangements should be made to have every wire concealed in the partitions, or if it is impossible to get inside a partition, to put the wires in a substantial moulding on the outside. Too much cannot be said against running common annunciator wire in bundles inside a partition. Rats and mice will eat off the insulation and then there is everlasting trouble. Put the wires into a tubing that cannot be eaten by the rats and mice, or, if the wires are used without the tubing, have an insulation that you are sure will not be destroyed, or nail the wires up separately. A person should not try to convince himself that rats and mice will not eat the insulation off paraffined wire. The writer has never seen any traces of rats eating the insulation off K. K. or rubber wires, and would be pleased to learn if others have ever had such insulation destroyed by such means. In such buildings as hospitals it seems criminal to run wires and tubing on the walls, but such is being done in some of the best buildings of this kind.

When the telephones are not scattered about much, No. 18 copper wire, B. & S. gauge can be used, or possibly a smaller size. If seven instruments were to be wired the eight wires could be run in a small channel cut in the wall; if the wires were covered with a thin layer of rubber and the rubber with a light braid, the whole bundle could be covered with a compound and the compound covered with the usual finish or with plaster of paris. Possibly to make a real good job a lead-covered cable would be best. The insulation on the wires in this case could be very light cotton, paraffined, and the lead need be but thin. The lead would make the most compact arrangement, and if it was lead cable that was run on the ceilings instead of dirty tubing, which it is impossible to get up neatly, the work could be done neater and the lead cover would be easily kept clean.

The factory with its unfinished walls seems like an easy place to run wires, but it is difficult to get in a telephone system, even in a factory, without much thought and care, if a good job is wanted. When annunciator wire is used every wire should be tacked up by itself and where the wires pass through the floor every one should have a separate hole. Never tack the wires close enough together so that metal double-pointed tacks can touch each other. Two wires should never be put under one metal staple or double-pointed tack.

When a factory building is new and the partitions and walls are clean, if the wires are well tacked to the woodwork and given a good coat of lead and oil, after once dry the wires are so well fastened that they can be swept over without disturbing them. In some places we see the wires run close together on small knobs; this is wrong unless it be a very damp or wet place. Through wet places the writer would recommend lead-covered cable, the cable to be covered with a molding unless well tucked away to prevent getting bruised.

When manufacturing buildings are separated some small distance apart, it is much better to use a piece of lead-covered cable to carry the circuits from building to building than to run the wires separate as so many wires side by side, even though they be small, make a hiding place for various things.

Where a combination of cable and open wires is used much care must be taken when the cable is feathered out not to leave the open end of the lead casing so that water can run into or moisture creep up into the cable as the wires are close together and the insulation very thin usually. Cover the end of the cable with some hot compound, having the cable quite warm, then bend it down, feather out the wires, and fasten each one to a small peg or tack it down firmly so that the wires cannot be moved where they come from the end of the lead casing. The end of the cable and the place where the wires are feathered out should be covered with a wooden block nicely fitted and the block screwed down tightly, especially on to the end of the lead cable to keep it from being moved about or pulled back from the wires that are fast. The permanency of the cable job depends very much on holding the ends of the cable firm. From the lower side of the block the wires can be spliced on to and continued through the building. As the wires are mostly inside of buildings there is no need of making provision for lightning arresters.

If the distance from building to building be more than a few feet, or so far that the cable cannot be supported from a 2 by 4 scantling by means of a piece of No. 14 K. K. wire wound around the two, a piece of cable similar to what the electric roads use for span wire, should be well fastened in one building and then pulled up tightly in the other and fastened; to this steel cable the lead cable can be secured by a No. 14 K. K. wire wound spirally full length of the span.

When it is decided to put the telephones in a factory, school building, etc., it is often a question whether to have a small central station, or to use the system in which each instrument is connected directly to a small board at every other instrument, so that a person at any one can call up another person at any other in the system without the use of a central.

The great trouble with the system with a central is that it often occurs that when a person wants to use the telephones there is no one at the switchboard. The writer knows of a high school building that cost about $125,000. The electrical devices are supposed to be the most convenient, but the telephone system is controlled by a switchboard in the office of the principal of the school. During school hours there is usually some person in the room where the switchboard is, but before and after school hours if the janitor wants to speak to some person that he may have working in some remote part of the building he has got to walk. This should not be. During the course of a short conversation the writer has seen the principal have to stop and answer a call at the switchboard. This is very nice at first, but a terrible nuisance after the novelty wears off.

Where buildings are scattered some 1,000 or 2,000 feet apart this system must be adopted if many telephones are used, but where the telephones are all in one building, the circuits not more than one thousand feet long the system with independent call is much the better.

In this article we will confine ourselves to the systems where no switchboard is used, or consider only the usual warehouse system, together with the system with two or more instruments on one circuit.

There are a number of firms, independent of the Bell Company, that are now manufacturing telephones that have had experience sufficient to enable them to make good apparatus. The instruments should be secured from reliable manufacturers or dealers; the transmitters should be carbon; the pattern with the granulated carbon seems to be the most popular; hence, in a commercial sense, it must be the best. Since there are no two people of the same height, and the instrument has got to be fastened to the wall, it should have an adjustable arm.

When the instrument is in place the mouthpiece should be at such a height that it is just midway between its highest and lowest position when in use by a person of medium height. If so placed the range of adjustment is sufficient to enable both the short and tall to use the telephone with comfort. No telephone job is a good one without the adjustable arm. It is very amusing to see a very short lady try to use

the average telephone; the same is true of the very tall man.

There are many telephones in use that have no battery box attached; this might do in some factories, but it seems like false economy to run an extra circuit for a battery, and the telephone is much harder to get connected with the line properly.

THE COUNTING AND CHARGING OF CABLE MESSAGES.

THE submarine cable companies of this city have issued some important information with regard to the rules which on and after July 1 will regulate the rules for counting and charging cable messages will be modified to meet the changes agreed upon by the International Telegraph Convention, held at Budapest, in 1896.

Messages may be written in plain language, code language or cipher language. Plain language offers an intelligible sense in one or several of the languages authorized for international telegraphic correspondence. In messages written entirely in plain language, the maximum length of a chargeable word is fixed at fifteen characters. Words of more than fifteen characters are charged at the rate of one word for every fifteen characters or fraction thereof.

Code language is formed of words of not more than ten characters taken from standard vocabularies of the English, French, German, Italian, Spanish, Portuguese, Dutch and Latin languages, or from the Official Vocabulary. In messages written partly or wholly in code language, the maximum length of a chargeable word is fixed at ten characters. Words of more than ten characters are charged at the rate of one word for every ten characters or fraction thereof.

Cipher language is formed exclusively of Arabic figures having a secret meaning. In messages composed of cipher language, every group of five figures or fraction thereof is charged as one word. Groups of more than five figures are charged at the rate of one word for every five figures or fraction thereof.

In messages written in plain language and cipher language, the words in the passages in plain language are charged at the rate of one word for every fifteen characters or fraction thereof; and the groups in the passages in cipher language at the rate of one word for every five figures or fraction thereof.

In messages written in plain language, code language and cipher language, the words in the passages in plain language and code language are charged at the rate of one word for every 10 characters or fraction thereof; and the groups in the passages in cipher language at the rate of one word for every five figures or fraction thereof.

Numbers expressed in figures are counted and charged at the rate of one word for every five figures or fraction thereof, each group being considered separately.

Trade-marks formed of letters are counted like figures, but when formed of letters and figures, the characters interrupt each other and are counted separately; example, a5c is counted as three chargeable words.

INDEPENDENT TELEPHONY FOR NEW ORLEANS.

A movement is actively afoot in New Orleans to organize a joint stock company to own and operate a new telephone exchange, and, judging from the fact that Mr. J. J. Fowler, late manager of the Great Southern, is interested and one of the prime movers in the new organization, it is expected that the project will be pushed forward with energy. The capital stock of the new company is fixed at $250,000, most of which will be subscribed for by local capitalists, but some of the stock will be floated in the North and East. It is the intention of the new company to have everything in readiness to perfect organization in the course of the next two weeks, and it is said that the initial meeting of the new company will be held before the 15th of July.

The new organization intends to, in the first place, reduce the price of the telephone service not only in private residences, but also in business houses, and to start in will fix upon a tariff of $30, and $50 per annum for telephones in dwellings and business houses, respectively. Each subscriber will be credited with 1,000 calls per year, and this number is deemed more than adequate to meet the demands of almost any residence or place of business. Snould, however, the 1,000 calls be exhausted before the end of the year the subscriber can, by payment of the original sum, receive 1,200 additional calls, and, if at the end of the year any of the calls should remain, they would be credited to tne ensuing year. In other words, say that 500 of the 1,000 calls remain at the end of the year, the subscriber would have to pay for only 500 calls the second year, which, in addition to the 500 calls remaining over from the first year, would entitle him to 1,000 calls the second year. This method would in a great measure do away with the indiscriminate use of the telephones by non-subscribers, and would tend to prevent in a great measure the frequent useless or unnecessary calls.

The company intend to use at once $125,000, on which to commence operations, leaving $125,000 in reserve. They intend to lay all their wires underground. Mr. Fowler, who has had great experience in telephone and telegraph construction, apprehends no difficulties whatsoever in placing the wires underground, and his velws are concurred in by the most experienced electricians and practical constructionists in the city. The new company intend to avail themselves of all the more recent and modern approved switchboards, appliances, telephones, etc., and expect to give the public a first-class service.

INDEPENDENT TELEPHONE LINES IN WISCONSIN.

While independent telephone toll lines, covering about 3,000 miles of line, have approached within forty miles of Minneapolis on the southwest, it is now announced that an independent company is planning to put independent exchanges in every town in northern Wisconsin, which has over 1,000 people. These towns will also be connected with long distance toll lines, which will reach from Minneapolis and St. Paul to Marquette, Mich. Among the towns which will be connected will be Eau Claire, Chippewa Falls, La Crosse, Winona, Wausau, Merrill, Bayfield, Ashland, Spooner, Stevens Point and their tributary towns. The work involves 200 local exchanges, 5,000 miles of toll lines and an expenditure of about $2,000,000. When completed, it is said, this system will be the most complete and extensive system of State toll lines in the country. If one of the independent companies now applying for a franchise in Minneapolis is allowed to put in an exchange it will connect with these toll lines. Leading Duluth and Superior capitalists are interested in the new company.

LOW RESISTANCE TELEGRAPH RELAYS.

AT the recent convention of the Railroad Telegraph Superintendents, the committee appointed at the last convention to conduct the low resistance relay experiments made its report through Mr. W. W. Ryder (C., B. & Q.). At last year's convention Mr. U. J. Fry (C., M. & St. P.) gave an account of some experiments he had made on his company's telegraph lines in the use of relays of low resistance (25 ohms) in place of the standard instruments (150 ohms each), and stated that the results were remarkable. With the low resistance instruments on wires that previously had had to be abandoned temporarily in stormy and wet weather there was now very little difficulty experienced, thus apparently indicating positive advantage in the use of the low resistance instrument. It was to investigate the subject further that this committee was appointed. The results of the committee's experiments during the year have been so conclusive as to leave no room for doubt.

Two lines of experiments were conducted, viz., the splitting of the coils of standard relays—that is, connecting the two magnets in parallel—and the use of low resistance, series wound, "pony" relays. The scheme of splitting the coils was tried on fifty-one circuits under the varying conditions of five railroads, and the results showed a decided improvement in service, especially in bad weather. The most marked improvement was obtained, however, with the use of a 25-ohm series wound relay. Lines equipped with these instruments work equally well in good or bad weather, as shown by the tests, and in every case the low resistance instrument worked much more satisfactorily than the one it replaced. Another important consideration in this connection is the fact that the battery power can be reduced in the same ratio as the instrument resistance, thus effecting a corresponding saving in battery material and maintenance costs. Telegraph engineers have always based their calculations on the old law that the combined resistance of the instruments on a wire should equal the resistance of the wire itself plus that of the battery. The committee's opinion is that this law never applied to telegraph circuits.

CITIZENS' TELEPHONE CO., Grand Rapids, Mich., an "independent" concern, reports 1,975 subscribers. It started last year with 500, and reports doing profitable business. It has 300 stockholders, 297 of whom live in the city.

ELECTRIC LIGHTING

THE HAMILTON, O., MUNICIPAL PLANT.

BY W. N. GRAY.

IN your issue of June 16, I notice a paper on "Municipal Lighting" by W. Worth Bean and feel that a few words should be said for the other side.

Mr. Bean's position is of course consistent if he is interested in the lighting business, and his paper was no doubt received with great satisfaction by his hearers, all of whom probably—if members of the National Association—would agree with him, and applaud his opinions. My objections to the paper are, however, that the arguments are too old; a good many of them beg the question, and then the writer is not at all sure of his facts.

While I have been in the electrical business for thirteen years and during that time have never advocated the operation of lighting plants by municipalities, and on some points agree with those who are opposed to such ownership, I have never been able to see that it was absolutely necessary that a municipal plant should be a failure, or that because city officials are usually corrupt, the people must therefore pay a profit to a corporation—often a foreign one—for what they can obtain at cost in another way.

Because some municipal plants have failed, proves nothing. How many private lighting companies have failed? Is it not possible that some of the municipal enterprises have been made to fail purposely through the insidious attacks of persons who, like Mr. Bean, are probably interested in seeing them fail, and through the constant, determined and very powerful efforts of the allied gas and electric light interests which are always on the alert to oppose city plants which may injure them. I have seen enough of the business to know that these interests will stop at nothing to prevent the success of municipal plants. And why should they? They are afraid of them, and when they assert that they will not succeed the "wish is father to the thought."

The stock argument against municipal ownership is that public officials are corrupt. Have you never heard of corruption in connection with a city lighting contract? When a town pays a lighting company $150 a year per lamp, or when there is competition and a contract is given to a company at $120, when there is a bid of $90, is it not safe to suppose that there is something in the transaction fully as unsavory as there could possibly be in the management of a plant by the same officials? As long as there are such things as city officials there will be corruption, and it seems to me that they might just as well work direct as to have the aid of a corporation, which aid in most cases simply increases the burden laid upon the people.

There is a great deal that is unjust, no doubt, in a city going into a business of this kind in competition with parties who are already in it, but I think if the facts were known it would appear that in a majority of cases the city plant was the outcome of the greed of the old company. Through manipulation of the officials and consequent large profits, corporations after a time begin to feel too secure, and act as if they "owned the town." They treat their customers with a scant courtesy; they hold up the city with outrageous lighting contracts; and then, when the people become roused and go into the business, they complain of what they have only brought upon themselves.

Now in regard to Mr. Bean's facts. I do not pretend to know the "inside" in regard to all of the plants he refers to—and he may be correct in regard to some of them; it would be strange if all of them were successful, and I will not make the mistake he does by referring to things I know nothing about. Mr. Bean is, however, unfortunate in referring to this city of Hamilton, and he is so far wrong in this case that a shadow of doubt is thrown upon all his assertions.

Through the pressure of the hard times of the last four years and the usual amount of bad management on the part of the Council—which can hardly be prevented in any town, and is chargeable to the people who elect them—the city finances have gotton into a tangled condition, and the revenue is not sufficient even for the legitimate expenses of the city. This has nothing whatever to do with the plant owned by the city. Municipal ownership has NOT cost Hamilton $575,000.

It is true that $625,000 has been spent for a water works, a gas works and an electric light plant, but I venture to say that no one in Hamilton except the owners of the private gas works would say that this money was lost, or that municipal ownership has "cost" the city this amount. It is NOT reported that an order is made to discontinue the light for lack of funds.

Last December, due to lack of cash, there was some trouble of this kind, but if the city had been lighted by contract it would have been just the same unless the contractor had been willing to wait six months for his money. Hamilton has NOT had an expensive experience in this direction, and the "taxpayer who has burned nothing but oil is NOT now helping to pay the bill."

I will show why:—In the first place $350,000 of the $625,000 referred to was spent for a water works, so that the large sum mentioned by Mr. Bean was not all sunk in a lighting plant, as one would suppose, and in this connection let me say that one of the most peculiar features of these attacks on municipal plants is the fact that water works are usually excepted.

People who will cry down lighting plants and talk about confiscation and robbery, etc., generally seem to think that the supplying of water is a legitimate business for a city to engage in and that it can be done honestly, too.

The water works in Hamilton are operated by Trustees; water is supplied for ALL city purposes free; the rates to private consumers are much lower than the average in towns of the same size, and not only are all expenses paid, but all extensions, interest on bonds, and some of the bonds themselves have been paid. Of the gas works and electric light plant I can speak more specifically: They are both fine pieces of property and are managed successfully by one Board of Trustees.

Twenty-five years ago the people of Hamilton paid $4 per 1,000 feet for gas; by hard work and long continued efforts they managed to get the price down to $2. While in other towns of the same size gas was being sold for from 80 cents to $1.50, the local company refused to reduce the price from $2, saying they would lose money if they did. The city then built gas works, put the price of gas at $1 and lighted the streets at about one-half the former cost. The gas company met the price and proved the falsity of their former claim by making a profit.

About two years ago the city built an electric lighting plant; whether it was a necessity or whether it was a wise thing to do, has little to do with the question. The people wanted electric light and were willing to pay for it, and they got it. The plant is large and rather elaborate and probably cost a little more than it would if it had been built by private parties. There is no doubt that before its acceptance it was run rather loosely, and like most new things took a little time to settle down and get into good running order, but it can not be said that it has ever lost money because the plant is operated principally for street lighting, and it has cost no more to light the streets than it should. The streets of Hamilton are lighted by 210 arc lamps and about 300 gas posts, and the allowance made the Trustees by Council is about $2,000 more per year (the city having a population of 25,000) than was paid the gas company ten years ago for less than 600 gas posts, the city then having a population of about 15,000.

Does this seem very bad for the taxpayers, the people who "burn oil?" Gas is supplied to private consumers at 80 cents per 1,000 feet, and the result is that the families who would probably be burning oil if the city had not built the works number about 2,200, 1,600 of whom are supplied by the city. Do you suppose that gas would be sold at less than $2 or that there would be over 1,000 gas consumers in the town if the city had not built these works?

The electric light plant furnishes 210 arc lamps for the streets, and the Trustees are allowed by Council per year per lamp for all-night service; current is sold to private consumers (metered) at 8 cents per kilowatt-hour (the prevailing rate in neighboring towns being 15 cents), and there are 3,000 lamps connected to the system. At these prices and with the worst kind of competition from the gas company (who are doing about one-fourth of the business) both of the plants are earning considerably more than their running expenses; in fact the plants are kept in good order, are continually making extensions, and are more than earning the interest on the bonds. If these plants were doing the entire business of the city they would be creating a sinking fund, but there are always some people who are susceptible to influences of various kinds, and the gas company do their share of the business, and work against the city, make charges against the plant and its managers which they cannot sustain, and then claim that city plants do not pay.

If it was a fact that these plants did not pay it would be the fault of the people who own them, and the very people who have the most to say about municipal plants losing

money are the people who aid the opposition with their patronage.

SOME THINGS ABOUT WIRING AND WIREMEN.—II.

BY S. H. SHARPSTEEN.

IN appearance the wiring inside the building should resemble Fig. 3. On leaving the main block, A, which is provided in all cases with a cover when not placed in a cabinet, the entrance switch, B, comes next; this should be some good make of knife switch and should open downward as illustrated in Fig. 3. It should be a knife switch for three reasons. The first is that a knife switch shows plainly that the circuit is open or closed. Second—It makes, or should make, a big break in both sides of the circuit, so that in case of a bad cross inside the house and current passing from high pressure mains the trouble could be remedied by opening this main switch. Third—During a bad thunder storm the knife switch of proper break can be opened and save the cracking on combination fixtures that is common in some places and unpopular with nervous people. The entrance switch should always be left open when people leave their homes for any length of time.

As seen in Fig. 3, the next thing we encounter is the meter, C. A meter loop should always be provided for in wiring a building. In many cases it might be advisable to have the meter on the floor below to save the meter man the trouble of entering the attic.

After leaving the meter comes the question of risers or mains. The wires pass down the gable end of the attic to the floor joist and through under the floor, if there be one, to a convenient place to go down to the floor below.

At this juncture we have to determine the size of wire for

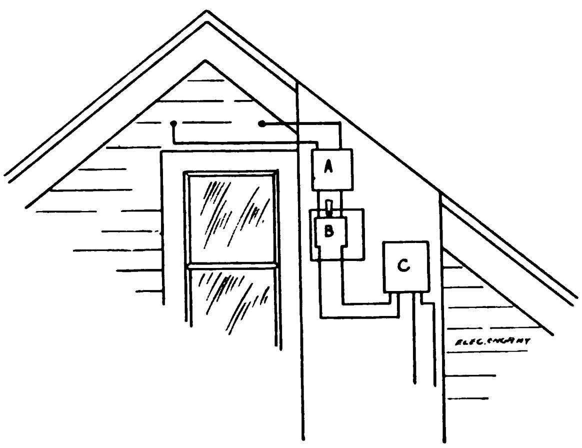


FIG. 3.

our mains. Some wiremen would conclude that all the lamps would never be burned at one time, and would commence by putting in a small main to start with; this the underwriters will not allow and it is poor practice, let it be where it may; it has cost much trouble in the past. We will decide on a No. 1 wire, B. & S. gauge, stranded, rubber-covered.

The matter of insulation will depend much upon what the underwriters may demand. In New York State rubber-covered wire must be used for concealed work, but just over the line in Pennsylvania K. K. or fire and weather-proof is used and allowed by the fire underwriters' inspector. If the floor joists run parallel with our wires we fasten one wire to one floor joist and the other wire to the next, having one floor joint between the wires. Knobs should be large enough so that the wire can be drawn up tightly and tied firmly.

If the wire has got to pass through the floor joist then the conditions are much different. Holes should be bored through them about 12 inches apart, porcelain tubes put in, and the wire run through the tubes. One of the first things that some people will think of when they see men running wire is, to saw a slot in the floor joist and lay the tubes and wire in that. Such practice weakens the floor joist very much if the wire is large, and if the wire is too close to the floor the carpenters are apt to drive nails into it. If the holes are bored in the usual way with bit and angle brace there will be some slope to the hole. The tube should be a good close fit in the hole, and the head of the tube should be on the high side, to keep it from working out with the jar of the building.

The mains should pass down through to the second floor in some place selected by the architect or owner, that will be convenient for a cabinet in which to put fuses to control the various circuits of the house.

Usually the mains would end at the fuse cabinet, and a branch run into the cellar for the lamps there, but in a city of any size the proper thing to do is to extend the mains into the cellar; then in case the street wiring should be put underground the house will not have to be torn up to get the proper connection with the street. In course of erection it is a small job to put in these extra wires and the expense of getting them in after the building is finished would be very much more.

ELECTRICAL CENTRAL STATION ECONOMIES.

BY I. H. BABCOCK.

THE business of the central station manager is, not only to "keep the wheels moving," but out of the material furnished him to develop results which will pay the investor a fair income upon the capital invested. If he cannot do this, either the enterprise with which he is connected is unworthy of prosecution, or else he is lacking in the skill and ability to utilize the elements of profit which are in the materials placed at his disposal. To throw away products which can be turned to profitable account and made to pay dividends is an evidence of lack of thrift which admits of no palliation. When we come suddenly from darkness into the light of day, we are partially blinded, and this seems to be the case to some extent in the electrical enterprises. There has been a sudden and wonderful development in this line, millions of dollars have been invested, and thousands of our brightest young men have enlisted to conduct the business affairs of these corporations. This development has been so rapid that many seem to be in a sort of maze, and have not yet taken a comprehensive view of the situation that surrounds them. The manager of an electric lighting company who possesses the technical skill to produce the most perfect light and yet has not the business ability to turn his waste products to practical account, cannot be said to worthily fill the position he occupies. He must look beyond the mere production of a dazzling light, however pleasant and attractive that may be. In Mr. T. C. Martin's very able paper read before the National Electric Light Association at Niagara Falls in June, he remarks, "It is as apparently true to-day as when the association was formed that the companies restrict themselves injuriously in their natural and logical advance by remaining mere lighting corporations." By so doing they are only doing business between dusk and daylight, and are standing idle all the rest of the time. Continuous work is necessary for the greatest success. Interest charges go on just the same if machinery and capital are idle more than one-half of the time. Mr. Martin further says: "We are led to believe that the isolated plants are the real backbone of the electrical power industry to-day. Why this is so it is difficult to explain, except on the hypothesis that station current when obtainable often costs too much, and is generally not obtainable." How then can we have continuous work, and how can we supply current at a profit, and yet so cheap that it will be called for in outside power work? I answer, by utilizing the by-product of exhaust steam, and making the lighting station a heating and power station as well. This added profit will enable the manager to increase his day work at a lower price. The more day work, the more steam produced, until soon the station is carrying a fair load at a profit during the entire twenty-four hours. Heat is as staple an article for eight months of the year as light. This proposition is neither a theory nor an experiment, as some of the more far seeing are doing this already with great success. Many managers sell exhaust steam enough to more than pay all fuel bills at the station. One manager states that while making no money in lighting, he yet pays 8 per cent. dividends on the entire capitalization for electric and steam plant out of the income from exhaust steam heating. The same thing holds good in street railway work. Resources and liabilities bear the same relation in electrical operations as in any other. The fuel bill at the station creates a liability, but when it evaporates a certain amount of water into steam, that becomes a resource. How shall this be turned to practical account, so as to put the most money in the treasury? The engine utilizes about 10 per cent. of the steam produced. When the remaining 90 per cent. is allowed to escape into the air it is a waste of resources, and if this policy is carried far enough it leads to insolvency. The gas companies, as competitors in lighting, maintain their ground by selling everything produced that has a value. When the electric light companies do the same thing they will have established themselves more firmly than ever in the field now occupied by them.

SHOULD GENERATING PLANT BE MOUNTED ON SPRINGS?[1]

BY JAMES SWINBURNE.

THIS is really part of a larger question: Should moving machinery be mounted on springs? The question concerns both the health of the moving machinery and of the people who may be moved by it. In central stations and in passenger steamers the shaking caused by machinery is most serious. In flour mills, for example, it is rather a question concerning the gear itself.

If we consider, say, a direct acting pump in space, it is a system that, of course cannot move its center of gravity as a whole. If then its pistons and plunger move in one direction the rest must move in another direction, the distance depending on their masses. Any imperfectly balanced machinery must, therefore, move its bed plate if freely suspended. A perfectly balanced engine is thus an engine whose center of gravity never varies relatively to its bed plate. This definition is really too small, because a moving system, such, for instance, as two cranks at 120 degs. on opposite ends of a shaft, do not change their center of gravity, but give the bed plate a rocking but non-translational movement. A gas engine with a flywheel similarly tends to rotate its bed plate at each impulse round an axis parallel to that of the shaft. A balanced engine is, therefore, really one which does not move its bed plate if freely suspended. Such an engine is practically never realized.

When an engineer sees an engine bed plate moving his first instinct is to bolt it down; it then moves a little less, but still moves, and he has a sort of feeling it must shake itself to pieces if allowed to move. Bolting down an engine to a bed of concrete is merely increasing the size of its effective bed plate, but the whole bed plate, including the concrete, must now be moved. It rests on the earth, moves slightly and communicates vibration to neighbors who are longing to be compensated for disturbance. Sometimes the concrete bed plate is isolated by mounting it on felt; that means that the larger bed plate is mounted on rather imperfect springs. A rather striking case is that of church bells. Bells are very much out of balance and the bed plates are mere cages of timber, so the bed plates would tend to move a good deal. The bell people do not like to see it move, so they wedge it to the steeple, and the result is a cracked steeple. The consequence is that you often hear that such a church has a very fine peal of bells, but they cannot be used, as the steeple will not stand it. Though this may be a relief to people whose ears are in tune, it might be cheaper not to make bells than to make them and hang them so that they cannot be used.

The question is, if the bed plate of an engine wants to move, why should it not have free play? As far as the engine goes, a little thought will show that all parts are subjected to smaller stresses if the bed plate is free to move. An engine will, therefore, wear longer if it is allowed to move its bed plate. As to the foundations, if the bed plate is allowed to move no foundations to speak of are needed, and there is no vibration communicated to the ground. The writer has tried this arrangement on a small scale. There is a small dynamotor on one of the top floors of Mr. Crookes' house which is very much out of balance and rendered the house uninhabitable at first. It is now on springs and makes no noise. There is also a dynamotor for electrolytic work in the writer's laboratory. It is on springs and no one has any inkling of a chance of complaining.

In passenger steamers the throb of the engine is exceedingly unpleasant—in fact, many people would rather go by a slower boat than travel 21 knots and be at the same time shaken 42 more knots by his pedometer. Mounting marine engines on springs seems rather a bold suggestion, and perhaps we ought not to begin there. The moving systems are so heavy in proportion to the fixed (or "attached" is the better word), that the marine engine is a particularly difficult case.

STEALING COLORED ELECTRIC GLOBES.

A dispatch from Oakland, Cal., of June 22, says: The beautiful colored globes for the electric lights in the grounds of A. Schilling, corner of Nineteenth and Jackson streets, have been stolen by the hundreds. The grounds have been open to the public heretofore and have been visited by a great many people, but if this vandalism continues they will be closed.

BROKEN GLASS.—An electric lighting company in New England was notified recently by the city authorities to remove from the streets broken glass falling out of its globes. The glass is a menace to horses and bicyclists, and there is an ordinance against letting it be scattered on the roadways.

[1]Abstract of a paper read before the Inst. of Civil Engr's.

WHAT ELECTRICAL ENERGY COSTS.—I.

BY ALBERT B. HERRICK.

THE cost of production of electrical energy is that value at which the whole output of the plant could be sold continuously, under the conditions of actual demand without a profit or without a loss. This statement is apparently controverted by the array of statistics involving all possible partial combinations of the items entering into a true cost; these published statistics form a disjointed, inconsistent mass of figures which cannot be analyzed with any result as to the legitimate cost of output, and each statement is a separate mystery as to what was charged against current production, as many items rightly belonging to this cost were relegated to other accounts.

These varied costs have common characteristics, which indicate what their probable function would be. The promoter's cost is an estimate of what the energy produced might cost, and includes generally an underestimate of development, investment and operating expenses. Fixed charges and depreciation are in many instances conspicuous by their absence; an overestimated demand, and the resultant combination of figures show a highly profitable undertaking. According to two well known writers, Niagara, three years ago, was to reach Albany, N. Y., 330 miles, with power at $22 per h. p. year; to-day, Buffalo, 15 miles from Niagara, is supplied at a figure near $30 per h. p. year.

Costs bear on their face an appearance of veracity which is not as a rule maintained on closer inspection, besides lacking items of actual expenditures for a given production. Neither the gross output nor the load factor is given, which have direct bearing on the costs cited. Such costs, when published, have a very bad effect on the electric lighting business, and establish precedents as to the cost of production which cannot be upheld in practice, and yet are not readily disproved.

These so-called costs operate in preliminary basic estimates as follows: A new station wishes to estimate the cost of producing current; operators of plants of a similar character are questioned; a certain plant, B, is generally selected as approximating to conditions of A's prospects, but A can condense, has free water and lower taxes than the selected case, and A's values are reduced to accommodate these improved conditions of operation. Yet it is overlooked that B supplies a class of customers who give him a load factor which allows him to capitalize for less per unit output, and which will more than offset in reduced fixed charges, any internal improvements of A. In this way A's price is based on the false assumption that they are analogous plants.

Then again, there are essential expenditures omitted or divorced from the costs which are necessary elements, even such charges as interest on plant, depreciation and unproductive labor; or labor and supplies required on repairs are charged to construction accounts. The construction and miscellaneous accounts seem to be flexible enough to include any charges the exact location of which is doubtful, and this doubt only arises from not having clearly before the mind that which constitutes a cost. It is these costs that are disturbing legitimate lighting and power industries, and the showing made by them establishes competitive electric light and power plants, and is the element which results in financial disaster.

The cost of power, developed in power houses for electric railway purposes is published for obvious reasons, and in a number of cases the items essential to the maintenance of the investment or returns on capital so invested, are disregarded; yet, why they do not enter into a statement of costs, is beyond explanation. In the upbuilding of any plant these charges are a more inflexible and inseparable part of the investment than the items usually added together and presented for consideration as a cost—labor, plus supplies, plus coal, plus repairs. All of the latter charges cease when the plant shuts down or is abandoned, yet the fixed interest charges are maintained against this investment as long as it exists, and these charges are disregarded as a functional part of the cost of output of the plant, and as long as their introduction in power costs are withheld, the value of the engineering feature in power plants, and its true worth, will be unknown to the art.

It must be said in defense of these various methods of arriving at partial power production costs, that they have a long list of lineal descendants as references for this practice; nevertheless, the perpetuation of an established wrong will not relieve the conditions which false costs have brought about in the electric current production industry of to-day.

These partial costs, among other things, have been used for the establishment of power plants for railways which have

been buying their power; through this medium of flexible costs a showing can be made that any railway can make power cheaper than it can buy it. There are several causes for this method of financiering, such as to secure the contract for the installation, to sell apparatus, and it may even come from within the company, as the plant extension may redound to somebody's advantage. Some recently published so-called power costs have several essentials missing, such as interest, fixed charges, taxes and insurance, all of which ought to be included in a true cost.

As to the effect on existing companies, of competitors with new and improved apparatus, there need be no uneasiness engendered so far as the electrical end of the plant is concerned; the gross gain in all electrical improvements instituted in the past seven years will not aggregate one-tenth of the gain, which would result, if the losses in the steam, operating in the engine cylinder were reduced one-quarter, and which can be effected by properly proportioning units to the output.

Viewing these railway figures for cost of power from another standpoint, some extraordinary results are arrived at in this way: The ampere meter, sometimes an old type, not within 10 per cent. of accuracy, is read half hourly! As a result of a number of tests, the reader of fluctuating currents will naturally take a higher, rather than a mean reading, and multiplying this again by normal voltage of dynamos will obtain the watts. The result of this method of taking power output is from 40 to 60 per cent. in excess of the reading of an integrating wattmeter, and consequently with the output determined in this way, and divided into the gross cost, a much lower cost per unit is obtained.

The street railway business has inherited from its predecessor the steam road, the "car mile" basis for figuring cost of transportation, and power stations are even to-day required to sell their product by the number of miles they propel the cars. Grades, weight of car, speed, controller, traffic density, track construction, line losses, motormen, are all variables which have to be considered if the results of different roads are being compared; hence, with the "car mile" basis for power cost of railways, there can be no comparable data.

The cost obtained by municipalities who contemplate doing their own illumination, is generally arrived at with such notorious disregard of general principles, as not to require serious consideration; besides, their political bearing, so obvious in many cases. Yet they are very hard to controvert, and they tend to establish a price, and their publication can only injure and menace established legitimate lighting industries. Matters have come to such a pass that conservative lighting companies are arranging for other business, so that they can lose or hold their city lighting, which source of revenue depends largely upon which way the wheels turn, as they do not care to depend upon such hazardous loads for fixed income.

Naturally this matter of cost is coming more to the front, as it is the all important element in financiering new plants, and as the most lucrative locations for electric light or power production are occupied, the true cost is becoming more and more bereft of elements which it should bear, so that the resultant figuring will show a comfortable profit and attract the unwary investor. The result is that the investing public to-day, looks at established electrical development investments with suspicion, and it has a just cause, and will continue to do so until the returns on the investments are figured on a legitimate basis.

These published costs act on every hand to the detriment of legitimate electric distributing enterprises. The large customers, by comparing their costs of current supply bills with some costs of current production, get the idea that their bills are too large. This false conclusion fosters the isolated plant idea, which is the worst thing that can happen to both parties and legitimate business, and false costs have again to be harmonized. The central station manager will probably recognize some of his troubles depicted in the above, as they are taken from actual examples met with by clients of the author.

Having now exposed the operation of the present usual method of determining cost, the writer will attempt to enunciate a proper system of making up costs. This is not a matter of bookkeeping solely; it includes largely common-sense, and any set of books can be analyzed where all expenditures are noted, and a true cost arrived at.

ST. PAUL, MINN.—The Board of Control has awarded the contracts for engines, dynamos and wiring for the new city and county hospital to Jas. G. Robertson, representing the Ideal Engine Company, of Springfield, Ill., for the engine; to the Western Electric Company, of Chicago, for the dynamo, and John A. Gorman, of St. Paul, for the wiring contract.

THE SPECTROPHOTOMETRY OF INCANDESCENT LAMPS.

BY W. R. TURNBULL.

IN the January 1, 1896, number of The Electrical Engineer, Dr. W. H. Birchmore published an article on "The Mistaken Ideal of Artificial Light Improvers." His curves are plotted from, and his paper is based on, a table of mistakes which unfortunately appears in Palaz's excellent book on "Industrial Photometry."

This table purports to come from O. E. Meyer, but the Beiblaetter reference[1] to Meyer's article gives tables which are, in main essentials, the same as the tables of other investigators. Apparently Palaz, in copying Meyer's table, did not give sufficient attention to having the ratios right, and therefore, the table gives, for the most part, the reciprocals of the proper values: e. g., Palaz gives $\frac{\text{Sunlight}}{\text{Gaslight}} = 4.07$ at the "B" line, whereas Meyer gives $\frac{\text{Gaslight}}{\text{Sunlight}} = 4.07$.

The result is that the entire table is a mistake, through which he attributes a large amount of blue rays to incandescent lamps, and it is surprising that Dr. Birchmore did not compare such startling results with the work of others, for to a worker along these lines, the error is apparent.

In aiming to improve our light sources, we should indeed take sunshine as the ideal and normal light, but the combined work of Schumann, Meyer, Vierordt, Nichols, Franklin and others shows that our artificial sources are weak, not strong, in violet rays and they are strong, not weak, in red rays. There is, therefore, no mistaken ideal in attempting to get higher percentage of blue rays in our artificial lights, for we need them.

Had this mistaken table been quoted by one writer alone, it would hardly have been necessary to call attention to it, but again, and more recently[2], it has been made use of by Mr. M. A. Edson in an article on "Vacuum Tube Lighting." In the context of this table (which is transformed into percentages) he says, "As is well known violet light should be avoided."

How has this become "well known" when it is in direct variance with the results of all workers who have studied the matter thoroughly? It is true that a violet light is to be avoided, just as a red light or a green light is to be avoided, but a light with its proper proportions of violet light, as determined by our natural illuminant, the sun, is to be desired and not avoided. The light from vacuum tubes often has a preponderance of violet and ultra-violet rays, but this is not always the case, for a tube containing traces of hydrogen gives a bright red light, one containing nitrogen, a purple light, and so on. It is probable that if vacuum tubes were filled with proper proportions of several different gases, before exhaustion, that the remaining traces of the gases would give to the light the proper proportions of all rays from red to violet.

I am sorry to have to speak so critically of the two articles above cited, but it is time that our inventors and engineers were helped by the investigations of physicists, who have studied the subject, and not misled and confused by articles which, were the tables on which they are based, corrected, would disprove just what the writers attempt to prove.

The following curves give the results obtained by Nichols and Franklin[3] and by Schumann[4] in extended studies of the incandescent lamp. Their results are in good accord with those of other investigators and may be considered typical.

Fig. 1 shows the proportion of colored rays in different sources of light; the light from a 16 candle-power Edison lamp (operating at normal candle-power) being taken as a standard of comparison and all of the sources being made equal to unity in the yellow region of the spectrum (at the "D" line). It is obviously necessary to reduce the intensity of the light from different sources to unity at some point (e. g., the "D" line), since we are only concerned with proportions of colors and could make no measurements, that would mean anything, by comparing the total brightness from sources such as the sun and any artificial light.

No. 1 is the curve for daylight, when the sky is clear, and it shows in a most marked manner how very intense the blue end of the spectrum is in comparison with the incandescent lamp (V) and with other artificial sources such as the arc light (III) and lime light (IV); although in the case of the arc light there is one region, in the violet, where the radiation is

[1] Beibl. Wied. Ann., 1880, p. 130.
[2] Western Electrician, March 6, 1897.
[3] Elektrotechnische Zeitschrift, May, 1884.
[4] Proc. Amer. Ass. for the Adv. of Sci., August, 1888.

unusually intense. Curve II shows that with a clouded sky, daylight is not so predominatingly strong in blue rays,

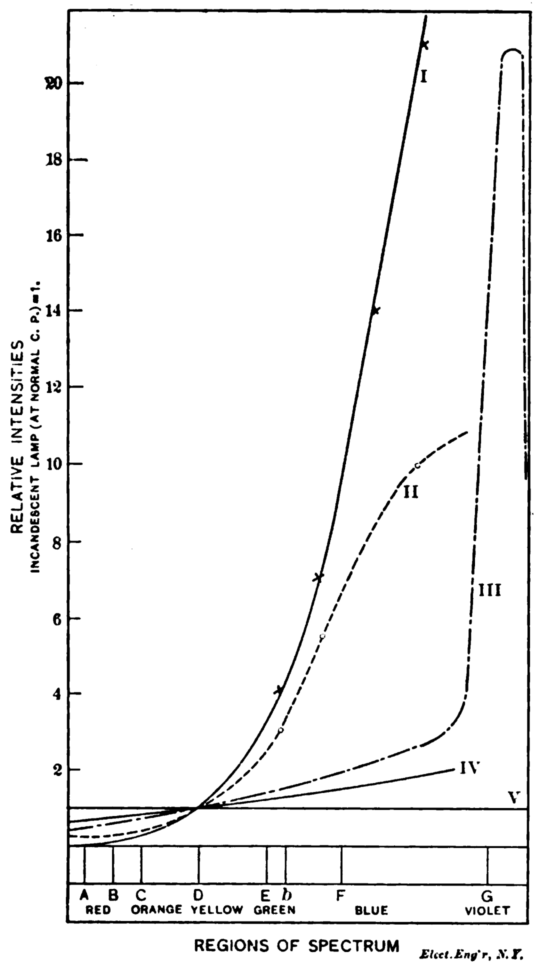


FIG. 1.—CURVES SHOWING PROPORTIONS OF COLORED RAYS IN DIFFERENT SOURCES OF LIGHT.—I. DAYLIGHT (Clear); II. DAYLIGHT (Clouded); III. ARC LIGHT; IV. LIME LIGHT; V. INCANDESCENT LAMP (Nichols & Franklin).

although it still shows itself much stronger than most artificial sources. Were curves for petroleum and gas plotted on Fig.

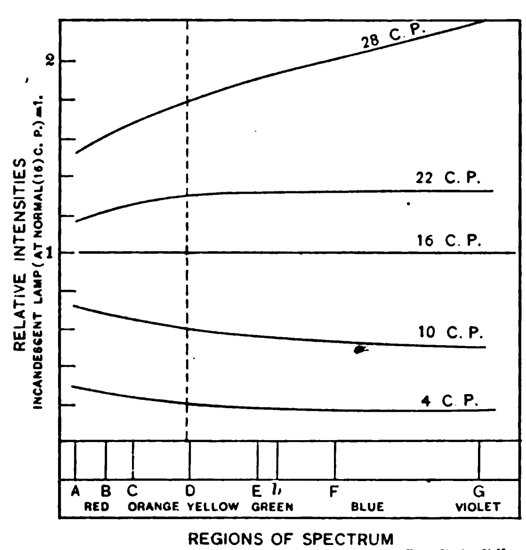


FIG. 2.—PROPORTIONS OF COLORED RAYS IN LIGHT FROM AN INCANDESCENT LAMP AT DIFFERENT CANDLE POWERS. (Nichols & Franklin).

1, they would be a little above curve (V) at the red end of the spectrum and somewhat below it at the violet end.

Fig. 2 shows curves for a 16 candle-power Edison lamp operated at the abnormally low candle-powers of 22 and 28, and at the abnormally low candle-powers of 10 and 4. It will be noted that at the red end of the spectrum the intensity increases more slowly than candle-power, and at the violet end the intensity increases more rapidly than candle-power. There

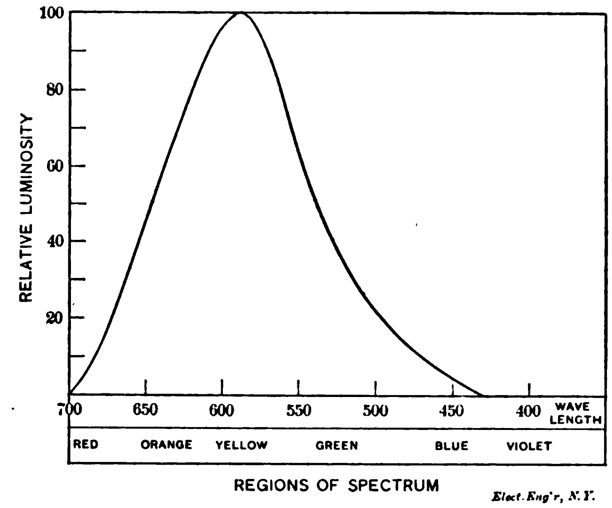


FIG. 3.—LUMINOSITY OF INCANDESCENT LAMP (Ferry).

is an intermediate region in which the intensity is proportional to candle-power and the dotted line in the figure shows at what position this holds true; it is in the yellow, very near the "D" line.

It is to be hoped that in considering Fig. 1, no confusion with luminosity will arise. The curves of Fig. 1 simply give comparative values for the intensities of different sources in

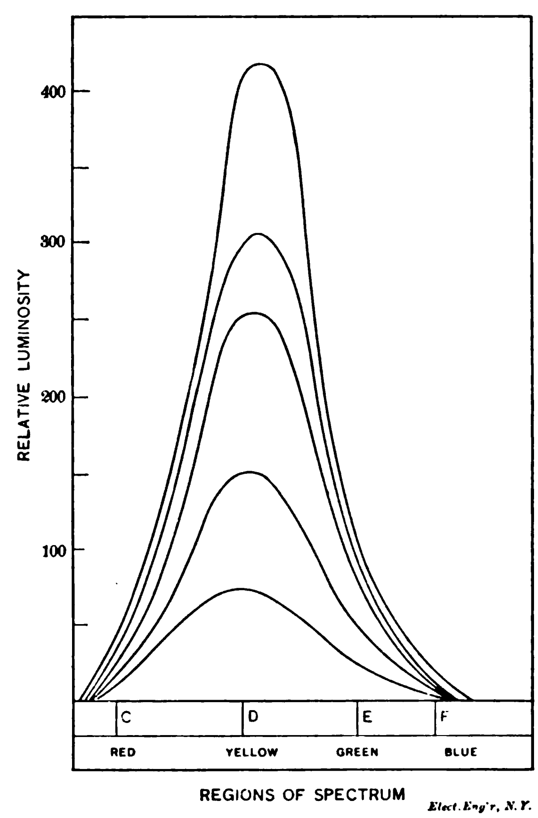


FIG. 4.—LUMINOSITY OF INCANDESCENT LAMP OPERATED AT DIFFERENT EFFICIENCIES (Schumann.)

different regions of the spectrum, when these sources are compared with a 16 candle-power lamp and when the intensities at the "D" line have previously been made equal. For example, No. 1 shows that sunlight, in the blue region, is proportionately 20 times brighter than the light from the incandescent lamp in the same region, and so on, but it tells nothing of the luminosity of a single source for any region

of the spectrum and it gives no comparisons of luminosities for different sources.

Information of this kind can only be obtained from such a curve as that shown in Fig. 3, which is the luminosity curve of an incandescent lamp at normal activity. This curve shows to what extent the different colored rays, making up its light, contribute to the light-giving power of the source.

Luminosity curves may be plotted in several ways, but the most usual one is to hold a book (one that necessitates reading, not inference, such as a table of logarithms) in the different parts of the spectrum and regulate the intensity of the light until one is just able to read the print at a fixed distance. Holding the book first in the red, then in the orange, and so on, the light will, in general, be decreased until the yellow is passed when it will have to be increased as we approach and enter the green, blue and violet. The inverse of the values thus obtained for intensity of the source, when different parts of the spectrum are considered, are then plotted as ordinates (the maximum luminosity being called equal to 100) and the regions of the spectrum are made the abscissæ.

This curve of Fig. 3 is similar in form to curves for most other sources of light having a complete spectrum, but it is, of course, not identical with these and for the incandescent lamp itself, the luminosity curve changes in magnitude and form as the watts per candle change. (See Fig. 4, from Otto Schumann's results[5].) The lowest of these curves is that for a lamp operated at a low efficiency, and the highest of them is for the same lamp at a much higher efficiency. Luminosity curves of all sources, that emit a complete spectrum from red to violet, must be similar in general form, from the very nature of our organ of vision with its limitations beyond both ends of the visible spectrum.

An examination of these curves shows that one ought to manufacture yellow light in order to obtain maximum efficiency, for yellow light gives a maximum return for the energy expended, but at the same time it is obviously necessary, for the health of our eyes, to have a light with the proper proportions of all rays in it, and no one, for instance, would advocate the use of the sodium light by which to read.

"The most important wave lengths, so far as light-giving power is concerned, are those which form the yellow of the spectrum, and the relative luminosity falls off rapidly both towards the red and the violet. The longer waves have, however, much more influence upon the candle-power than the more refrangible rays, as will be seen by an inspection of the curves Fig. 4, the relative falling off of the red end of the spectrum being compensated by larger and larger accessions in the blue and violet as the state of incandescence increases.

"Luminosity is the factor which we must take into account in seeking a complete expression for the efficiency of any source of illumination, and the method to be pursued in the determination of luminosity must depend upon the use to which the light is applied. If we estimate light by its power of bringing out the colors of natural objects, the value which we place upon the blue and violet rays must be very different from that which would be ascribed to them, if we consider merely its power of illumination as applied to black and white. In a picture gallery, for instance, or upon the stage, the value of an illuminant increases with the temperature of the incandescent material out of all proportions to the candle-power, whereas, candle-power affords an excellent measure of the light to be used in a reading room[6]."

It is not my object to go further into this subject at present; this paper simply strives to correct a mistake which already has become far too wide-spread, and if it serves to make matters at all clearer regarding both the composition of the light from different sources and the meaning of the term "luminosity," it will have served its end.

NIAGARA POWER IN BUFFALO GRAIN ELEVATORS.

Not only will one elevator in Buffalo use Niagara power to handle grain, etc., but two of these great structures in the Queen City will use the transmitted energy to operate their machinery. The latest to announce their intention to avail themselves of the power is the Electric Elevator Company, whose elevator building is now going up on Buffalo Creek. They will take 450 horse-power, and the motors have been ordered. Electricity is popular with elevator establishments because it is less likely to create fires than power generated on the premises.

[5]E. L. Nichols, Proc. A. I. E. E., May, 1889.
[6]E. L. Nichols, l. c.

THE HISTORY OF AN X-RAY BURN.

BY S. H. SHARPSTEEN.

An account of the X-ray trouble I have had may be of interest to the readers of The Engineer. During the latter part of December, 1896, I was experimenting to find the best position of the body in relation to tube and plate in order to get a picture of the hip joint. There was a young man in the shop who used to help me with that work, and I had him lie on a table back down, with clothes all on. I placed the tube over the body near the point where the abdomen wall joins the leg. The tube was large size, double focusing, current high frequency; the small anti-cathodes in the tube were of platinum. Most of the time anti-cathodes were at low red heat. The anti-cathodes were about 6 inches from the body or skin. The exposure was about twenty minutes. The plate was not affected much, and I could not see the outline of the bone.

After about ten days the young man's leg became sore, the skin came off, and a physician was called. Our company also had a physician see the boy. Our physician thought that the wound was commencing to heal and that the young man would soon be out to his work. During this time he used to take a car near his home and go to see his physician. About a month from the time the young man's leg began troubling him he was in the shop and expected soon to go to work, but the next thing we heard was that the flesh had died to a depth of about ⅛th of an inch and about 1½ inches in diameter. At this writing, June 2, 1897, the young man is still in the house with the wound as large as a silver half dollar.

About a week after the young man was exposed I exposed my wife, same set, same place exposed, same tube, time of exposure about thirty minutes. After ten days the skin turned a dark red color and commenced coming off. Carbolic salve was applied for a time, and later a physician was called. By this time the wound was sloughing serum and the doctor had Squibs' sub-nitrate of bismuth put on it occasionally as part of the dressing, the other part was vaseline and carbolic acid. The sloughing was checked some, and soon the wound appeared to get better. Size of wound about 1½ inches in diameter. After about three weeks the skin stopped growing, sloughing had ceased, wound commenced to get inflamed; the bismuth had formed a thin layer over the wound up to which the skin had grown.

At this time the physician dug off the layer of bismuth; the nerve action seemed all right as the whole procedure of removing the bismuth was painful; the circulation was there as the wound bled during the removal of the bismuth. This was about seven weeks from time of exposure and flesh was not dead yet, but one week from this time there seemed to be a layer of dead tissues and in about two weeks this tissue was as dead and tough as a piece of sole leather and as large as the original wound.

The doctor treated the wound with proto-nuclein after the removal of the bismuth, leg swelled and became inflamed and patient was compelled to take to her bed; until this time she had been about the house during the day, bending slightly to favor the wound when she walked.

At this juncture I took my wife to the Post-Graduate Hospital, New York, and left her under the treatment of Dr. Seneca D. Powell. After about twelve days of hot carbolic applications the inflammation and swelling were diminished very much, and Dr. Powell dissected out the ulcer and left a place about 4 inches long by 3 wide, and in some places it was over an inch in depth. Almost immediately the flesh commenced filling up where it had been cut away and now, six weeks from time of operation, the wound is nicely filled in.

There are several things to be considered.

I don't think that the X-rays had anything to do with affecting the flesh as a long exposure with an abundance of rays passing through the body at 2 feet distance from tube will not affect the tissues in a harmful way. A person can get a good bright screen 10 feet from tube, but cannot detect any sensation upon the softest tissue in the body, whereas if he gets closer to the tube there is a decided sensation. If the X-rays are harmful to the flesh why will they not affect it, regardless of distance from the tube, as long as they are present in abundance?

1. After careful consideration I am of the opinion that the harmful effect comes from the pulsating current passing

through the flesh outside the tube. It seems reasonable to think that under so high a pressure the pulsations would, to some extent, be transmitted through the medium near the tube, be it flesh or otherwise. This would explain how Prof. Thomson got an X-ray burn through a piece of metal placed over the flesh during the exposure. If the piece of metal had been large enough it would no doubt have taken the pulsating current of electricity and protected the part exposed to the X-rays.

2. The flesh did not become dead until about two months after the exposure; if the proper treatment had been pursued at once the affected tissues possibly would have rallied and become sound again.

3. The condition of the health of the persons subjected to the rays has something to do with the trouble. I had been using the same outfit and style of tube for various X-ray exposures, just previous to the time that the two troublesome cases were exposed. I took an X-ray picture of a bullet in a man's leg above the knee, exposed him longer than the cases mentioned and had no trouble.

ELECTRICALLY DRIVEN PLOUGHING TACKLE IN GERMANY.

FROM time to time during the last ten years and more, says "Engineering," we have heard rumors of steam and horses being supplanted in ploughing by electricity, but the affairs have usually been only experimental and have led to no permanent results. Lately, however, the system has been worked out in Germany on a commercial basis, and we are now able to lay before our readers illustrations of machines constructed by Mr. A. Borsig, of Berlin, and now being used in many localities. Electric ploughing tackle is best adapted

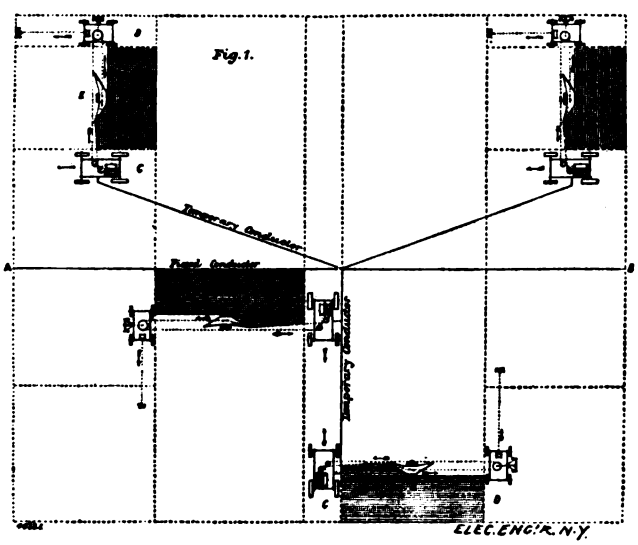


FIG. 1.—ELECTRIC PLOW CIRCUIT ARRANGEMENT.

to meet the requirements of the great beetroot estates in Germany, which are devoted to the manufacture of sugar, for they are of large extent, and have command of capital to enable them to adopt all labor-saving appliances. Further, there are, on such estates, large installations of steam power, which lie idle a great deal of the year, including that period at which ploughing is done. Hence, by the addition of dynamos, and of a system of overhead conductors in the fields, it is possible, at small cost, to adopt electric ploughing over a large area.

The overhead conductors do not extend into all the fields, but are tapped by temporary wires laid on the ground, as required. Fig. 1 shows eight fields, with four sets of tackle at work, all drawing current by temporary connection with the overhead wire A B. Each set of tackle comprises a "motor wagon" C, an "anchor wagon" D, and a plough E, which is drawn backwards and forwards between the other two, cutting five furrows, as shown by the parallel lines. On the motor wagons is fixed a 40 horse-power alternate current motor, with necessary switches and driving gear, both for the hauling and traveling, while the anchor wagon carries the anchor, and a sheave round which the hauling cable runs. It is possible with an electric conductor of 500 meters (1,640 ft.) and a ploughing rope of 300 meters (985 ft.) working length to plough 222 acres from one center of operations.

The motor wagon, Fig. 2, carries two drums on horizontal axes. On these the two ends of the rope are wound, the bight passing round the sheave on the anchor wagon. One drum is driven to draw in the rope, while the other runs under a brake, to keep the tail rope fairly taut. The two parts of the

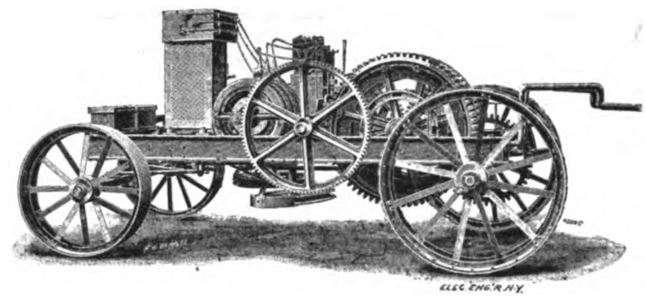
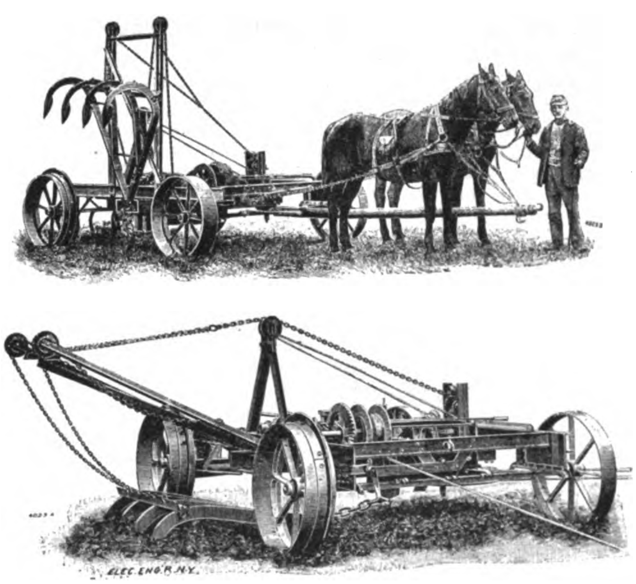


FIG. 2.—ELECTRIC PLOW MOTOR WAGON.

rope are led round guiding sheaves, revolving in horizontal planes, under the wagon. The two rear wheels can be connected to the motor by clutches and gearing to propel the wagon, while the two leading wheels serve to steer it. On the opposite side of the wagon to that shown in the view, there is a platform for the attendant, with the various handles and levers grouped in front of it. The weight of a motor wagon is 7 tons.

Mr. Borsig states that with fixed steam engines of 250 horse-power, and with five ploughs, 6,000 acres of medium heavy ground can be ploughed to a depth of 14 inches at a cost of 92 cents per acre. If separate engines have to be employed, the cost per acre is increased by 14 cents per acre.

The anchor wagon, Figs. 3 and 4, carries a sheave round which the ploughing rope runs. The sheave is fixed in a



FIGS. 3 AND 4.—ELECTRIC PLOW ANCHOR WAGON.

guide, and is connected by a chain to the anchor. Hence as the anchor sinks into the earth under the pull of the rope, the sheave and it move together. The anchor itself has four prongs, and is hung from a light crane, or derrick, by which it can be completely raised for traveling (Fig. 3), if the jib be wound up by the worm hoist at the opposite side of the frame At other times it is manipulated by the chains running round the pulleys at the head of the jib. The slack end of the ploughing rope, when the plough is moving towards the motor wagon, actuates gearing which winds the anchor out of the ground, and moves the anchor wagon forward into the right position for the next double set of furrows. At the same time the anchor and sheave are moved backwards relatively to the frame to allow for the slip of the anchor in the earth. The anchor is then dropped by the attendant and the next set of furrows cut. The strain of the rope goes direct from the pulley to the anchor, and not through the wagon frame.

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GROUT ON MUNICIPAL PLANTS.

THE latest number of "Municipal Affairs," a quarterly issued by the New York Reform Club, contains an article by the Hon. E. M. Grout in favor of municipal gas ownership for New York; an article by Mr. A. R. Foote controverting the other; and a rejoinder by Mr. Grout. The three are extremely interesting reading, and although the arguments are addressed to the subject of gas, they would, of course, apply in general with equal force to the municipal ownership of electric lighting plants or street railways. In fact the discussion does cover electric lighting not only inferentially, but directly, and the merits of that part of the subject are also gone into in some detail.

The value of Mr. Grout's article may be gathered from the fact that he quotes Philadelphia as an example for New York at the very moment when a scathing report has been presented urging "that it is better to lease or sell the works while they are yet valuable than to wait until their main value is destroyed by competition, fostered and maintained by inadequate management." Philadelphia buys more than half of its gas supply from a local company at 37 cents per 1,000 cubic feet, and it makes a profit on this by selling it again. Its own municipal plant and staff make 10,000 feet per day per man, when the average should be 30,000.

But we can leave Mr. Grout's fantastic gas figures to gas experts and journals. Mr. Foote polishes off a good many of them in neat style; and as Mr. Grout very ingeniously proposed to revise his paper after it had been answered, Mr. Foote neatly provides for that policy of evasion by quoting Mr. Grout bodily in his own text. It is evident that Mr. Grout does not relish being pinned down in such fashion. Turning, however, to the electric light figures given in his "rejoinder," which he obviously thought was safe, we find that most of them are derived from the notorious falsifications of the soi-disant "Prof." Frank Parsons and are two years old. Still, to take them as they stand, we note, for one instance, that Boston, Mass., with $139 per lamp per year from a private company is compared with Braintree, Mass., municipal plant, $66 per year. Very beautiful and convincing! But what are the facts? The arc lamps in Boston are 2,000 candle-power, 10½ hours per night, 30½ nights per month. The arc lamps in Braintree are 1,200 candle-power, 7.7 hours per night, 27½ nights a month. In other words, the Boston lamps give nearly double the light nearly twice the time, and yet Mr. Grout has the audacity to hold this up as an example of superior municipal cheapness, when on the most casual investigation he would have seen that Braintree was paying too much for its lamps. Another example cited by Mr. Grout is Alexandria, Va., with lamps at $72 per year. The last report from that city is that there is a strong movement to sell the plant, as the electrical service alone is operating at a loss of $1,000 per year, while the citizens are intensely dissatisfied with the running of things and the inadequacy of the service. Such articles as Mr. Grout's make us sick, yet we have no doubt it will be peddled out as the latest truth and gospel about municipal ownership.

FAN MOTOR WORK.

THE summer has thus far been cool beyond the ordinary, but with the coming of the Fourth of July a hot spell begins as usual, and the one now here will last with little interruption until some time in September. This heated period is the season within which the fan motor has of late years made itself most useful and conspicuous, creating a new branch of industry and throwing upon the central stations a load that forms an appreciable part of the total, in hot weather, when lamps and power motors are least taxed.

It seems to be accepted in some quarters as a self evident fact that only in very hot summers can one expect a fan motor boom, and that the fan market is necessarily dull if the months of June, July and August happen to be at all cool. Our own impression is that a demand for fan motors may be created that will last the year around, so far as the manufacturer is concerned, while the unused opportunities for introduction, even in winter, are still numerous. We know some offices and rooms where the fan remains always in circuit ready to help ventilate or cool the place. It is not always convenient to throw doors and windows wide open, for example, after several people have been smoking in a room; but if a fan motor is handy, the air can be quickly changed and the room freshened up. The same idea applies to the sick room or the bedroom, or rooms in which food is served. Fan motors can add a great deal to the comfort of life, altogether aside from their function of stirring up a breeze in a down-town office in midsummer.

One branch of work upon which we still build high hopes, is the more general employment of fan motors in hotels. The average hotel bedroom is a stuffy place, and in summer it is often more restful to stay out of them than to try to win sleep within their walls. We believe that hotel proprietors can materially add to their income and to the popularity of their houses by putting a fan motor in every room occupied by a guest. At any rate, if one hotel tried it, we venture to assert that competing hotels simply could not escape doing the same. In large apartment houses, also, where the bedrooms are frequently small, inner rooms, the use of fans would be a great boon and would help to secure staying tenants.

When we consider the large areas of the world, outside this country, where intense heat has to be endured, it does seem likely that in due course a large export trade can be built up in fan motors. It is a branch of business this country has little or no competition in. England, Germany, or France, where the fan motors might be made, are almost wholly ignorant of their uses and advantages, and have not at all studied the many points connected with their manufacture. Regions like South America, the West Indies, South Africa, Egypt, India have a ready welcome for this neat little modern appliance of comfort, and are rapidly becoming better equipped with the requisite sources of current supply. One other field of general utility is that of ship board, where electric current abounds, and where a good breeze between decks is a perfect boon at any season of the year, and particularly in the tropics. Altogether, the market for fan motors has but barely opened up.

NATIONAL TELEPHONE TOLL TRUNK LINES.

ONE of the most important underlying questions discussed openly or quietly at the Detroit independent telephone convention, was that of toll lines. Many of the independent local companies are building, or have built such lines. Others have "pooled their issues" so as to enjoy in common a toll system connecting their various local systems; and as one speaker put it, great States like Wisconsin are already covered with the webs of independent toll lines. But it is when the competing system comes into rivalry with the superb network of the American Telegraph and Telephone Company's long distance lines, that the absence of anything to compare with it is deeply felt, and the weakness of the independent service without it becomes painfully apparent.

How shall this condition of affairs be dealt with? If the expectations of Mr. J. E. Keelyn, of Chicago, are realized, the time is rapidly approaching when telegraphing, telephoning and possibly the postal system of the United States, will be operated upon sound business principles, in which the government will have supervision and, to some extent, a co-operative interest, and in which the charges will be limited to a

figure insuring a fair profit on the investment, but also providing a perfect service. The plan may take any one of several different forms, but the most feasible and probable is one involving a trunk system of wires, extending East and West and North and South, built by the federal government and operated partly under its control, though not necessarily so. These trunk lines will furnish a means for the establishment, through existing telegraph and telephone lines, of a system of interstate communication, covering the entire continent. The plan has merit, but we doubt whether the government just now or at any time wants to add to its big burden of debt and worry by owning and operating telephone or telegraph trunk lines. It would be better to have the government hold its hands off, just as it would be better to have the post office operated by private management, and thereby become efficient. If there is profit in such trunk or toll lines, the capital will in due time come forward to build them, just as it has to create the new independent telephone exchanges all over the country.

NO TAXES IN GLASGOW.

IF there is anything that makes the plain, average Glasweglan tired, it is to be told that they pay no taxes in his city. This, however, is the charming legend that has been going the rounds of the American press for a long time, and now, we regret to note, the "Scientific American" gives credit to the same yarn in a column editorial, approving and recommendatory. The original form of the legend was that all the city expenses were paid out of the profit of the municipal street railway system. We pointed out recently that the city has a debt of $39,852,175, with 10,000 employés drawing $10,000,000 salaries per year, and that the nominal return of profit from the municipal street car system was about $45,000. Now this revised version crops up, and is attributed by our contemporary to a Mr. J. A. Johnson, in the "Morning Call," of San Francisco. We do not distinguish Mr. Johnson, but we venture to say that if he asserted that "the city of Glasgow, Scotland, is in the fortunate position of being able to pay all the expenses of the city government out of the revenue derived from its public improvements" he doesn't know what he is talking about or is intentionally misleading. What does the statement mean? What are the "expenses" referred to? Are the salaries of $10,000,000 per year included? If the city is making so much money, why is it fortunate because it wants to borrow large sums in addition to the thirty-nine million dollars it now owes?

We have some acquaintance with Glasgow, and should greatly hesitate to hold it up as an example to any modern American city, although it is deservedly proud of being the second city in the United Kingdom. Its vaunted street car service would not be tolerated in America, and it is in itself one of the reasons why the poor are so crowded that the city wants to tear down the slums in which they live. A system of fares prevails which operates against the poor man and prevents his living in the suburbs, while the system of our American street car lines is building up everywhere the finest suburbs of sturdy house owners the world has ever seen. And as for the absence of taxation in Glasgow, we respectfully request the "Scientific American" to interview any decent citizen from the dirty city by the Clyde and ask him what he thinks about it. Our contemporary will soon ascertain that Glasgow is not yet the socialistic heaven where everybody can get everything for nothing at nobody's expense.

ELECTRIC SAFE BURGLING.

THE recent scare engendered among banks and other money institutions by the announcement that safes could be readily perforated, with evil intent, by the aid of electricity derived from convenient lighting and railway conductors seems to have subsided somewhat; but that the subject is still occupying the attention of safe experts is evidenced by a letter which we publish on another page. Our correspondent's account, however, would have been more convincing if he had not withheld the data which he refers to, and which would have an important bearing on the point at issue. His experiments, like all others of the same kind, do not, to our mind, prove anything. The ability to weld a hole in a piece of metal by means of an arc is one thing, but actually to open a safe by that means without the use of explosives is another. So far as we are aware that has not yet been done. That the burglar is willing to give the method a trial, however, is shown by the report that at Chagrin Falls, O., recently, gentlemen of the craft tried to enter a safe by the aid of current, obtained from the railway circuits. We are told that they had "nearly succeeded in melting off the knob" when the current was shut off, as is the railway company's custom at midnight. It would be interesting to know further details of this pioneer experiment; among other things, how long it took to "nearly melt off the knob" with a 500-volt railway current. Indeed one might almost wish that the burglars had succeeded in order to set at rest a question that seems to give rise to so much unnecessary uneasiness. In the opinion of those best qualified to judge, the successful breaking of safes by electricity is highly problematical and until the fact is actually demonstrated we must continue to express our doubts as to its "commercial" feasibility.

AUTOMATIC TELEGRAPHY.

IN this week's issue Mr. P. B. Delany brings to a close his most interesting and valuable review of the state of the art of telegraphy as it exists at the present day, with reference to obtainable speed of transmission. While advocating a system in which he is personally interested, it will be admitted, we believe, that Mr. Delany has treated the methods in vogue at present in a fair and unbiassed manner, and if this be so, then it may well be asked whether improvement is not desirable. Mr. Delany has gone far enough into the practical working out of his ideas to set at rest all questions of that nature, and we understand that his automatic system will, in all probability, soon be given a practical, commercial trial. As to the broad criticism that the system is not adapted for general work, that is a point which will probably always be raised against any automatic system, no matter what its nature. The paying quality of any automatic system must depend upon the volume of traffic or the load factor, if we may borrow that term from another department of electrical work. Indeed the problem presents itself very much in the same manner as does that of the relative advantages of steam and electric traction on present steam roads. It is the great volume of business that now goes by the comparatively slow mail, which Mr. Delany desires to see transferred to the wires and not the short telegram which is still the last resort of the majority of business men. Mr. Delany's system bears all the imprints of a practical method, but whether he succeeds, or not, his governing idea of a telegraphic post is bound, sooner or later, to come to a head.

ELECTRICAL ENGINEER VOLUNTEERS.

SINCE the suggestion by Dr. John Hopkinson, a year ago, that the English electrical engineers form a volunteer corps as an adjunct to the regular Corps of Royal Engineers, considerable progress has been made, and it is now announced that an organization has been effected, and a code of regulations issued. The new volunteer corps has as its honorary colonel Lord Kelvin, with Dr. John Hopkinson as the commanding officer, while other well known and able English electrical engineers have signified their willingness to accept commissions. The objects of this newly organized corps are briefly stated on another page. Warlike operations on land and sea to-day involve electrical operations in so many forms that the eminent value of a trained auxiliary body of electrical experts must add immensely to the fighting strength of any country fortunate enough to possess one. Indeed, so well are we impressed with the importance of the matter that we would strongly urge the formation of a similar corps within the ranks of the American Institute of Electrical Engineers. President Crocker might well give this matter his serious consideration, and we predict a rousing reception for the U. S. Electrical Engineer Volunteer Corps with him at the head.

IN the early days of the X-ray it was suggested, in this journal, among other places, that the new phenomenon could be utilized at custom houses. The idea is now being tried practically by M. Pallain, French Director General of Customs, who has had apparatus fitted up in the customs room of several of the larger frontier railway stations. The results are so far said to be satisfactory, and if further results are equal to the present, the method may be generally adopted in France.

ELECTRIC TRANSPORTATION

THE WILLARD SECTIONAL THIRD-RAIL SYSTEM.

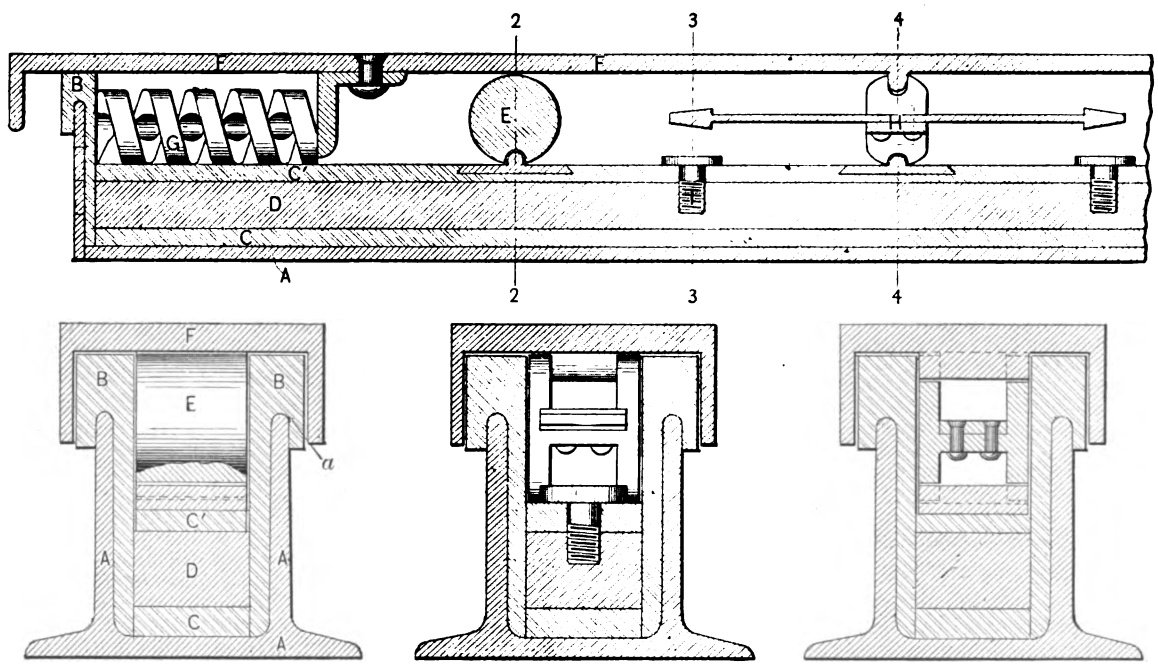
PERHAPS the only objection raised against the third-rail system of conductors as established on the New York, New Haven & Hartford R. R. is the fact that the third rail is "alive" and therefore liable to lead to accidents. With this drawback in mind, Mr. W. A. P. Willard, Jr., of Boston, formerly employed on the Nantasket Beach branch of the N. Y., N. H. & H. R. R., has designed a system in which each rail becomes energized automatically as the train passes over it, and becomes "dead" immediately after the contact shoe passes off the rail to the next, which is energized in turn.

The accompanying engravings illustrate Mr. Willard's system in detail. Fig. 1 is a longitudinal section of one-half of the rail. Fig. 2, a section through line 2 2; Fig. 3, a section through line 3 3, and Fig. 4, a section through line 4 4.

In Fig. 2, A is an iron trough rolled in suitable lengths; B B is an insulator made in lengths equal to the iron trough and held in place at the top by hooking over as shown at a. C. is also an insulator and also continuous. It also serves to hold B in place at the bottom of the trough. C' is also an insulator. D is the "live" conductor surrounded by the insulators, B C C', which in turn are protected from the weather by the iron trough A A. E is a supporting roller and is used to support the contact top, F. A loose spiral spring, G, is placed at each end of the rail. H is the contact rocker and is represented in a "dead" position. I is a flat-headed bolt connected with the live conductor, D. It will readily be seen that a short longitudinal motion given to the contact top, F, will compress the spring, G, and give to the rocker, H, a quick motion connecting the "live" conductor, D, through the bolt, I, and rocker, H, to the contact top, F, and as soon as the shoe has passed to the next rail the spring, G, quickly moves the contact rail, F, back to the "dead" position as shown.

The whole of this rail being made of iron and wood, it can be built very cheaply and as all the wearing parts, G, H and E, are very cheaply made and simply dropped in position, it requires no skilled labor to make repairs; hence, the maintenance of this system is estimated to cost very little.

The conductor, D, has an area of nearly eight square inches, and being made of heavy carbon iron will safely carry a large current. The amount of drop in potential in operation of this system will be about the same as in any well constructed insulated line.



FIGS. 1, 2, 3 AND 4.—WILLARD AUTOMATIC SECTIONAL THIRD RAIL SYSTEM.

NEW G. E. 52 RAILWAY MOTOR.

THE General Electric Company announces a new street railway motor, of less capacity than the now well known G. E. 1,000, but of greater capacity than the familiar G. E. 800.

The new G. E. 52 motor, Fig. 1, has an output of 28 horsepower rated according to the G. E. standard basis, i. e., a maximum rise of 75 dgs. C. in the temperature of the windings after a run of one hour at rated load, the temperature of the surrounding air not exceeding 25 dgs. C. The G. E. 52 motor is intended only for ordinary street railway work and is not recommended for the heavier service to which the G. E. 1,000 motor is adapted, and will accommodate electric brakes; but as some additional capacity is required for brake service, the company does not recommend this motor for such work except in purely street railway service.

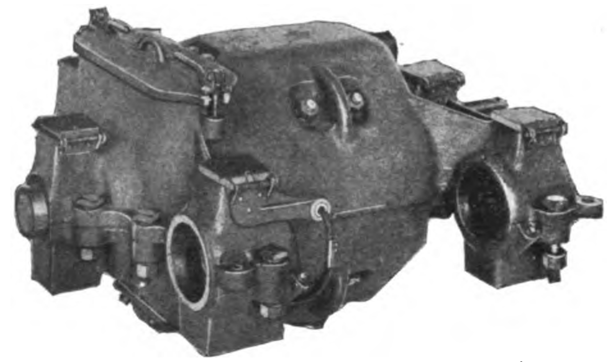


FIG. 1.—G. E. 52 RAILWAY MOTOR.

The frame is of steel, cast in two bowl-shaped pieces, and hinged and bolted in such manner that the motor is practically water and dust proof. A hand hole, fitted with cover plate and gasket, is let into the lower half, directly beneath the commutator, permitting easy access to the bottom of the motor for inspection or for the removal of any foreign substance. The motor has four poles, each with its own coil. The pole pieces,—and in this feature the motor differs from the G. E. 1,000—are laminated, but are bolted to the frame in the same manner as in the G. E. 1,000, the bolts extending through the frame.

The large bearing surface of this motor is one of its most important features. The armature bearings, designed for the use of oil or grease, or both, are of the following dimensions: Pinion end, 7¾ in. x 2¾ in.; commutator end, 6⅝ in. x 2½ in.; they are constructed on the "outboard" plan. The upper sup-

port for the lining is cast with the upper half of the motor frame, and when the lining is in place, there is a space of one inch in the cored recess, between the inner end of the lining and the motor frame. This space is occupied by a combination thrust collar and oil guard. The thrust collar is extended through the motor frame into the recess where it acts as an oil guard. This portion of the collar is a tapered disc, 6½ inches in diameter. The lower support for the lining is a cap bolted to the upper half, but not enclosing the lower half of the oil guard. This allows free outlet to the oil or grease. With this construction it is impossible for the lubricant to work into the motor.

The field coils are wound with asbestos covered wire and "mummified." Each is held in place on its respective pole by means of the pole piece projections, supplemented by a spring steel plate, and is placed in position before the pole piece is bolted to the frame.

The armature is of the well known iron-clad hollow core type, 11 inches in diameter with a spread of 9 inches with three ventilating ducts. There are twenty-nine slots in its periphery, each slot containing three coils formed into a compact unit, consequently there are twenty-nine sets of coils and eighty-seven commutator bars. The small number of coils is

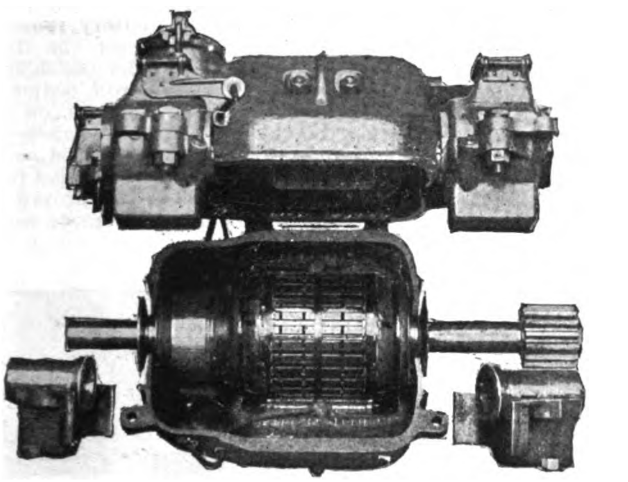


FIG. 2.—G. E. 52 RAILWAY MOTOR.

of special advantage in the matter of armature repairs, while the method of forming them in groups of three admits of a substantial insulation of high quality.

The standard gear ratio is 4.78 with taper bore pinion having 14 teeth and a cast steel gear having 67 teeth. Higher speed gear ratios may be used, furnishing increased speed with proportionately decreased tractive effort.

The brush-holders are standard and staggered to prevent the wearing of ridges in the center of the commutator. Each holder contains two radial brushes, 2¼ inches long, 1¼ inches wide and ½ inch thick.

The suspension can be either the nose, the yoke, or the sidebar, as with the G. E. 1,000 motor. The yoke suspension is especially recommended, as with this suspension the weight of the motor is carried on springs, placed upon the side frames of the car trucks. Lugs are cast on the upper half of the motor frame, to which the suspension bar is bolted, the motor being suspended from the top half. This permits easy access for inspection or repairs, as the lower half can be swung down into the pit, as shown in Fig. 2.

When the motor is mounted on 33-inch wheels, the clearance between the bottom of the motor and the top of the track rails is 5⅞ inches. The clearance between the bottom of the gear case and the top of the track rail is 4⅝ inches, a feature which railway men will appreciate. The motor without gear or gear case, weighs 1,450 lbs.; complete, and with 67 tooth gear and malleable iron gear case, the weight is 1,725 lbs.

LOS ANGELES, CAL.—The Main street and Agricultural Park street railway lines have been relaying their track with standard 6-inch, 60-pound rails, with the object of substituting electricity for horse power. It is the last animal power line in the city.

MR. C. P. HUNTINGTON states that his Southern Pacific Railroad is seriously contemplating the use of electricity on its broad gauge lines at Oakland, Cal., with some 40 miles of track, carrying 17,000,000 people for the ferries.

MISCELLANEOUS

STORAGE BATTERY ENGINEERING PRACTICE.—XVI.

BY JOSEPH APPLETON.

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STORAGE BATTERIES IN EDISON STATIONS—(Continued).

THE Philadelphia Edison Electric Light Co. installed last year a storage battery plant which has a greater capacity than any other individual battery in the world. There is one at Hartford, Conn., in which the cells are larger, but

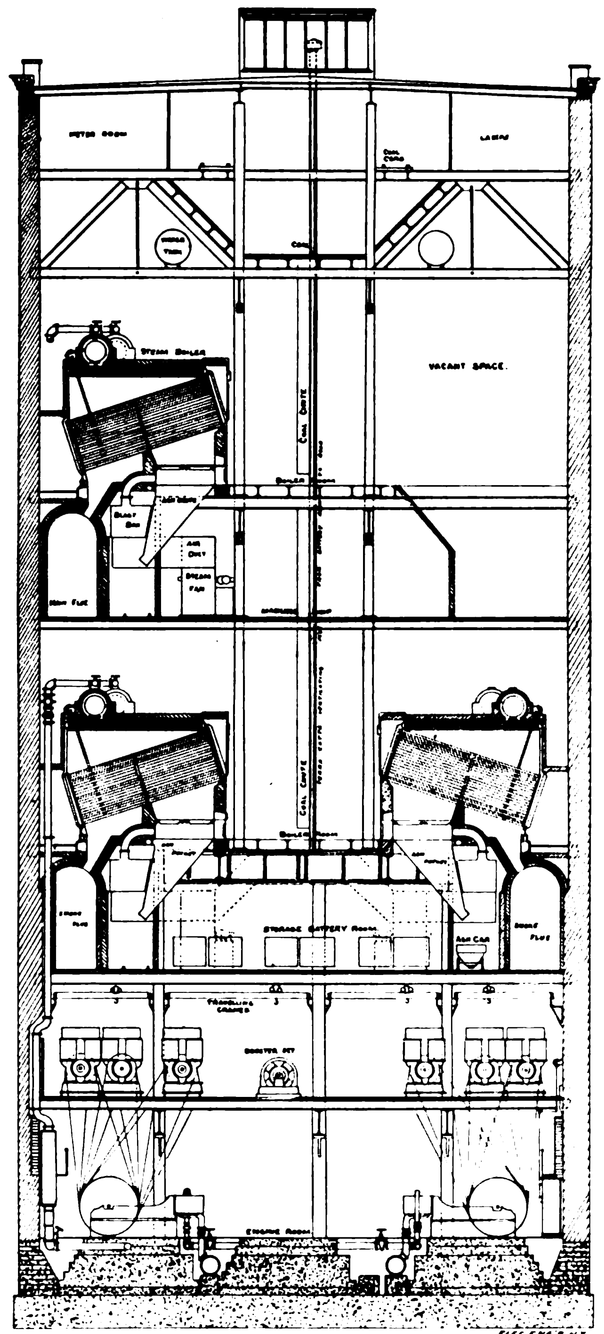


FIG. 62.—STORAGE BATTERIES IN PHILADELPHIA EDISON STATION.

the total output of the battery is not so great as fewer cells are used; this plant will be described later.

The storage battery at the Philadelphia Edison Station consists of 160 cells. Each cell contains 57 plates 31" x 15½", the dimensions of the lead lined tanks being 46" x 18" x 39¼" deep inside. The capacity of this battery is 1,520 amperes for ten hours; 3,750 amperes for three hours; 4,500 amperes for two hours; or 7,500 amperes for one hour.

This plant is especially interesting and worthy of notice on account of the care with which all the details have been studied and worked out, it being, undoubtedly, the most complete central station battery plant ever installed.

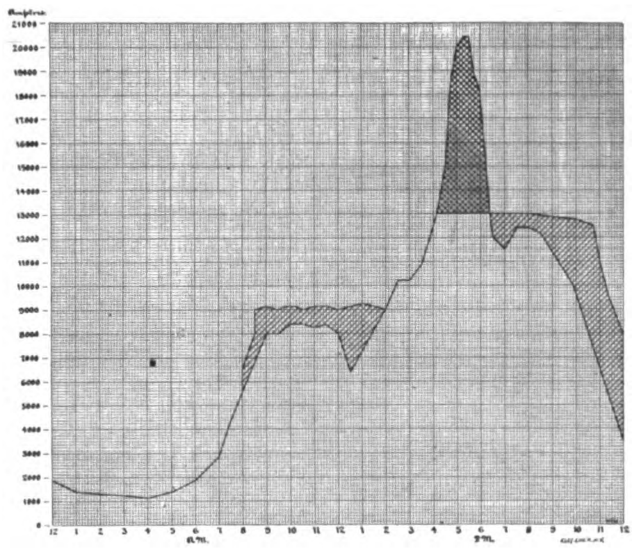


Fig. 61.

The Philadelphia Edison Co. have one large station from which all the current is distributed. The generating plant consists of 26 Edison bi-polar dynamos belted to Armington & Sims engines, having a total capacity of 26,000 amperes. Fig. 61 shows the load curve for a winter's day. In 1896, it became necessary to provide additional capacity in the station, and after most careful consideration the Edison Company decided to install a storage battery, instead of more generating machinery, believing that by so doing they would get a better return on the investment. The results have fully justified this belief.

The general arrangement of the battery plant is as follows: The battery is located on the third floor which was formerly used as a machine shop and store room. Fig. 62 shows a section of the entire station and gives a good idea of its general arrangement of same. Fig. 63 shows the interior of the battery room, and Fig. 64 illustrates the arrangement of the cells, also the run of copper conductors between the end cells and the regulating switches. These switches are located on the main stairway of the building, on the outside of the battery room wall; they are mounted on channel irons built into the wall, and so arranged that the connecting studs project through into the battery room where they are connected to the copper conductors. The battery switchboard, from which all the operating is done, is located on the main switch gallery of the station, in the dynamo room, on the second floor immediately underneath the battery room. Fig. 65 illustrates the method of connecting the storage battery equipment to the general system.

We will now consider the various portions of this plant in detail, commencing with the battery and battery room.

The battery being located immediately over the dynamo room, special precautions were taken to render the floor thoroughly water-proof. After the additional iron beams were laid, they were covered with a layer of concrete, on top of which was placed three thicknesses of tarred paper coated with pitch to render it water-proof; on this was laid chemical brick set in cement for about one-half the depth, the remaining half being filled with hot pitch. This has proved to be a most satisfactory construction, being inexpensive and fills the conditions in every way.

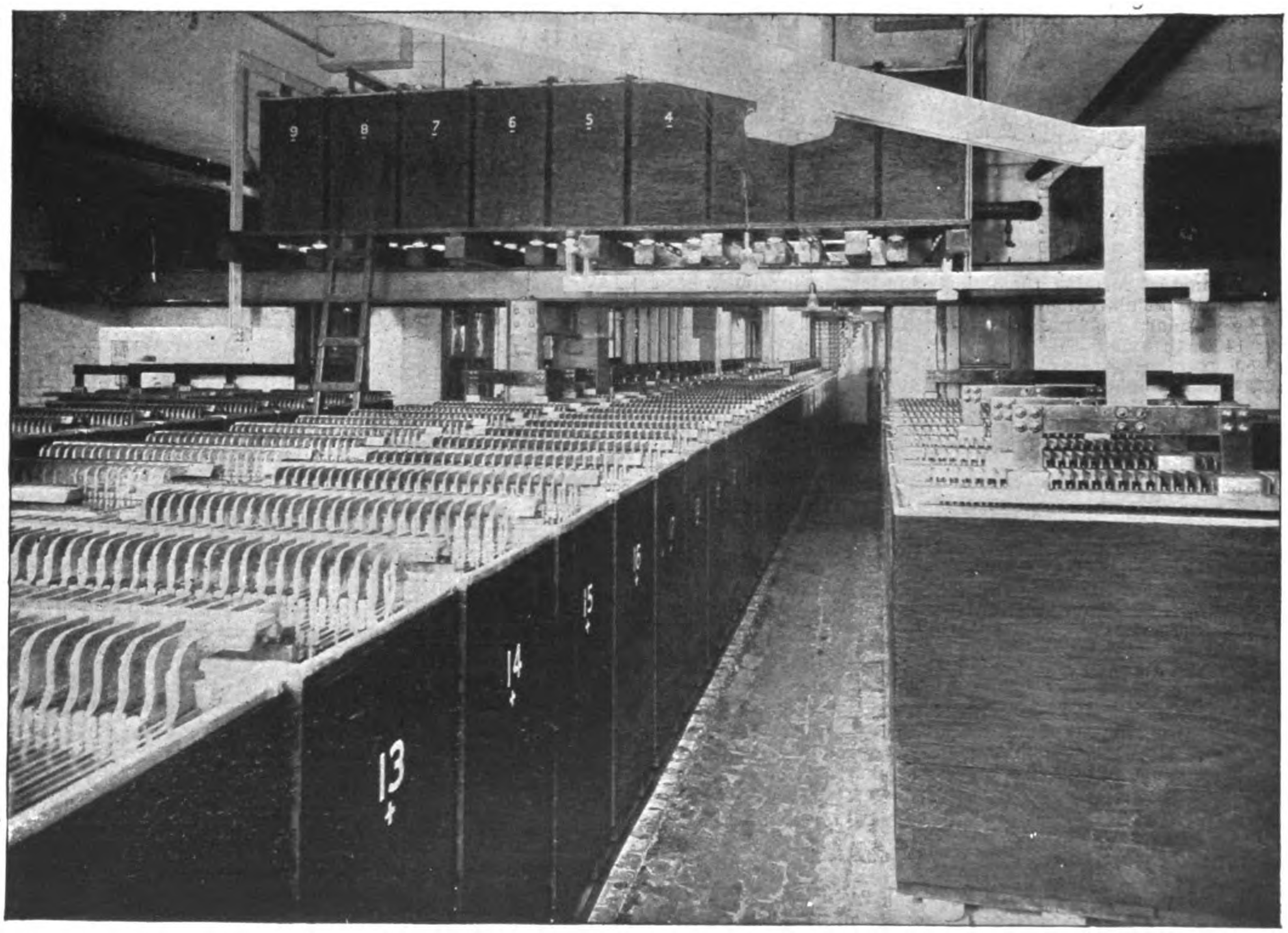


Fig. 63.—Battery Room, Philadelphia Edison Station.

The aisles are graded so that any liquid will drain off through the drains provided. The cells are supported on eight special double petticoated porcelain insulators, which are set on vitrified tiles to raise them slightly off the floor.

This arrangement gives good insulation between cells, also between the battery and ground. The battery tanks are constructed of well seasoned ash, 1¾ inches thick, dovetailed together and lined with 4 pound lead.

The plates in the cells are supported on sheets of glass as and one which secures the equal working of all the plates in the cell.

Thirty of the end cells on each of the three-wire system are connected to the cell regulating switches, so that any number from 51 to 80 may be used on the system. The connections

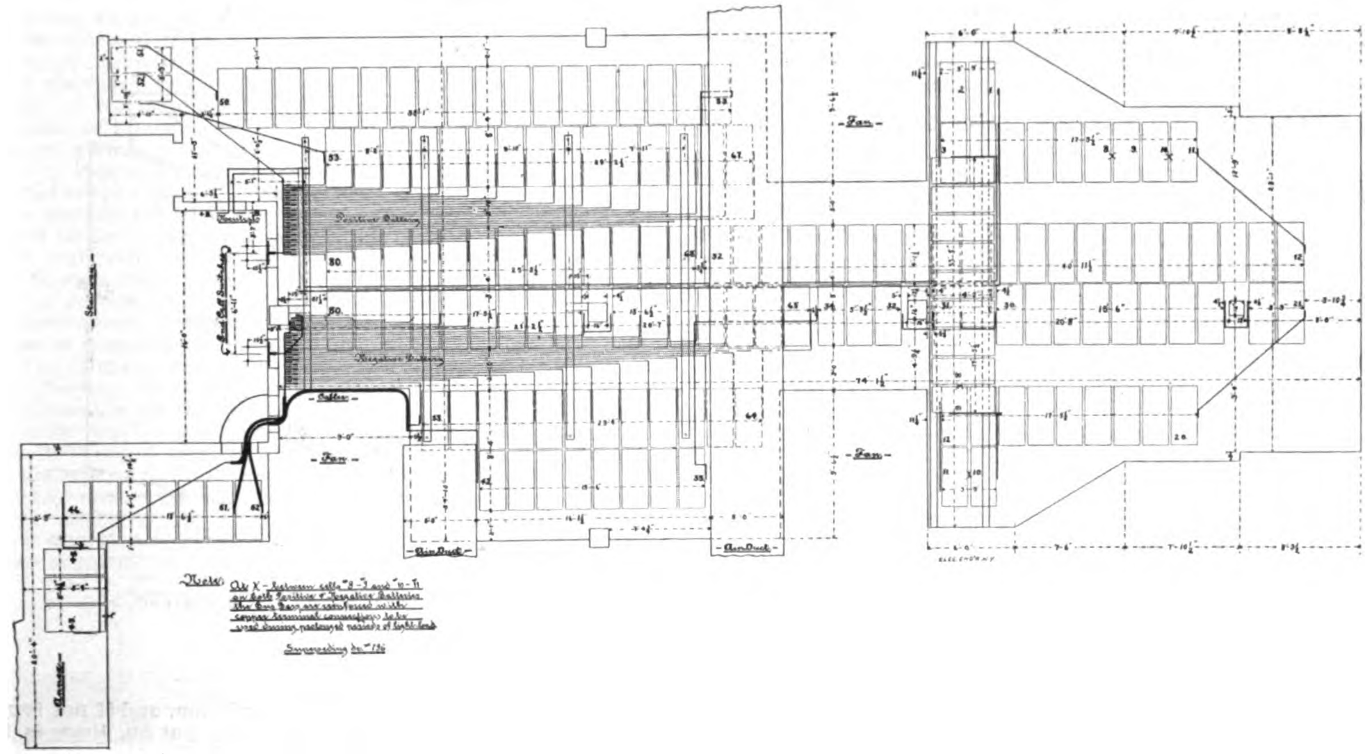


FIG. 64 —CELL CONNECTIONS IN BATTERY ROOM, PHILADELPHIA EDISON CO.

shown in Fig 2. All the plates are burned to rolled lead bus bars which also form the connection between adjacent cells, connecting them in series. All cells from which external connections are taken, either for the cell regulating switches, or to join one group of cells with another, have the lead bus bars re-enforced with a strip of copper placed underneath between these cells and the cell regulating switches are made with rolled copper bars supported on porcelain insulators mounted on channel irons hung from the ceiling. These copper bars have a sectional area of two square inches; the horizontal runs are made with bars 4"x½", while the vertical lengths consist of two pieces 4"x¼", placed on each side of the

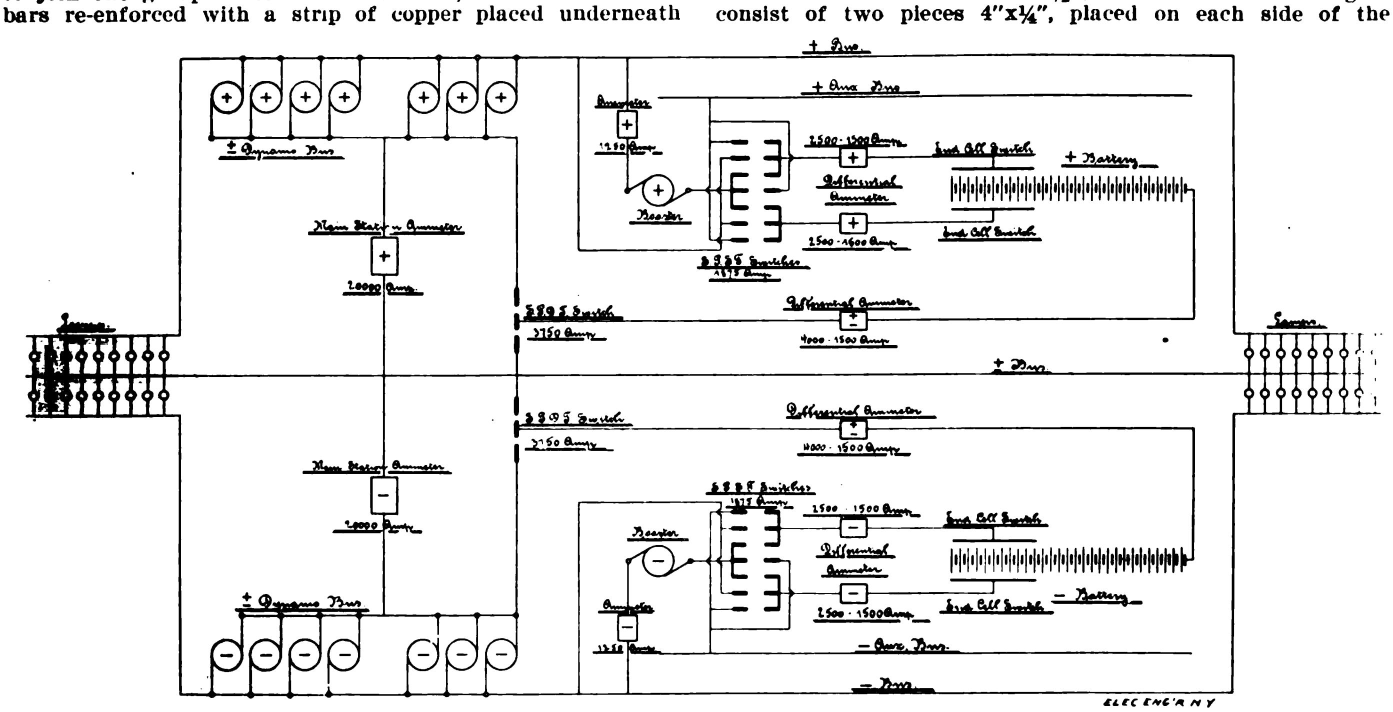


FIG. 65.—CIRCUITS OF STORAGE BATTERIES IN CONNECTION WITH THREE-WIRE SYSTEM, PHILADELPHIA EDISON STATION.

same, and thoroughly sweated in with solder, then coated with lead for protection from corrosion.

On the top of these bus bars lead cups are provided into which the copper conductors are sweated; these conductors extend through the lead bus bars to the re-enforcing copper strips to which they are brazed, thus giving an excellent connection horizontals so as to give double the contact surface at the joints.

All the joints are bolted together with four ⅝-inch bolts, the surfaces of the copper bars being treated with the Edison Brown plastic alloy; the joints made in this way have given excellent results, showing a lower temperature than the cop-

per bar itself when the maximum current is flowing. All the copper conductors are painted with an enamel paint to protect them from the acid spray and gas which is given off while charging the battery.

The battery room being in the middle of the building, means for ventilation had to be provided. This was done by running two 12 inch terra cotta flues right to the top of the building which, with the windows at the end of the room, provide ample ventilation without the use of fans or blowers.

ELECTRICAL MACHINE SHOP PRACTICE.—II.

BY JAMES F. HOBART, M. E.

COMMUTATOR segments are now made in several ways, the two best of which seem to be by drop-forging from the solid bar, and by casting and then drop-forging to a finish of the exact size required. Some shops prefer the latter method for extra nice work. Segments thus made, cost a trifle more, I believe, than those made entirely under the drop hammer.

Setting up commutators, while usually done in the ring with a double row of setscrews, can sometimes be well exe-

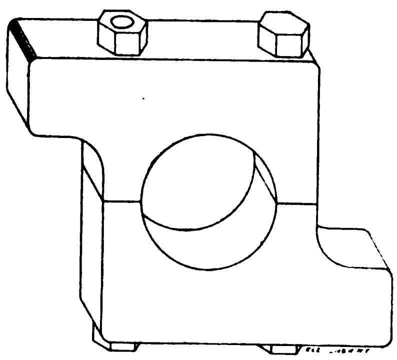
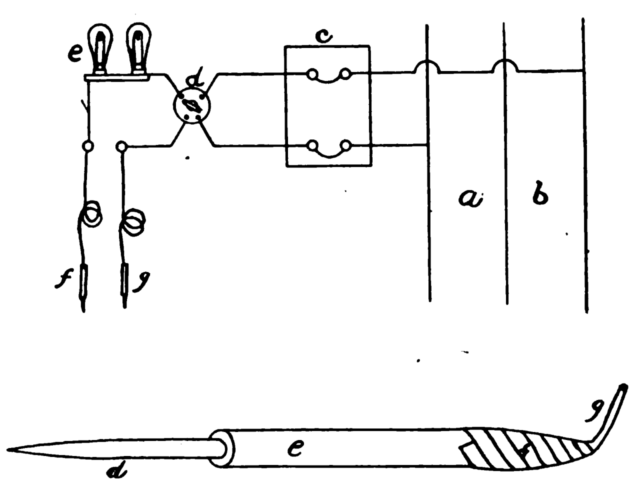


FIG. 4.

cuted with the clamp shown in Fig. 4. This is a solid cast iron affair, made, as shown, to be pulled up tight around the commutator, by means of the two turned bolts that fit pretty snug in reamed holes. At least, the holes are reamed at the points where the two parts of the clamp come together, in order that there may be no offsetting of the clamp as it is screwed together. A couple of stout dowell-pins can be put in, if found necessary, to relieve the bolts of the lateral strain.

The commutator being set up, and clamped up while hot, is baked to consolidate the insulating material, through a heating of the shellac, or other substance used for cementing the



FIGS. 5 AND 6.

mica, or other insulating substances. After this clamp has been screwed home, and the commutator baked while screwed up in it, there is little question to expect otherwise than the commutator will come out perfectly round, and otherwise in excellent condition. Another good thing about this clamp is it can be used for a lathe dog, as well as a clamp while turning up the ends of the commutator, for the reception of the conical collars which hold it to the armature shaft.

Being made symmetrical, the clamp is perfectly balanced, and can be run at high speed for brass turning and finishing. The projecting arms serve as "tails" to the dog, while driving the work in the lathe. The commutators had better be tested while in the clamp, as it is frequently the case that small cop-

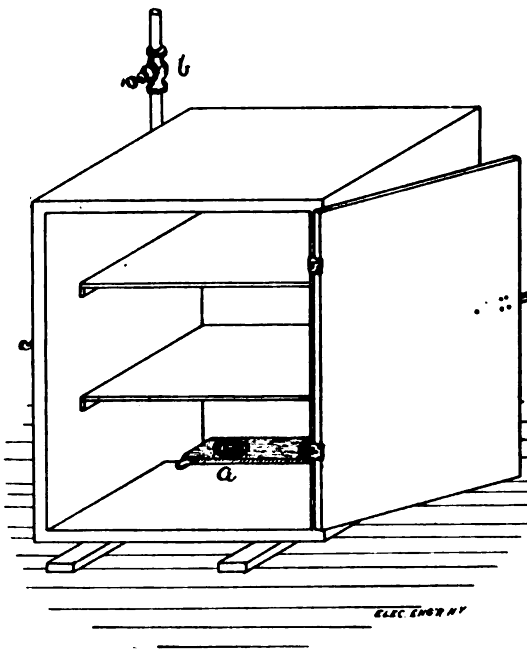


FIG. 7.

per chips get driven into the mica insulation, and if not found and removed before the cone collars are put on, there is the necessity of taking the commutator all down again to get them out, and that is an expense to be avoided.

Testing can be easily provided for while the commutator is in the clamp, by wrapping some mica, or other insulating material around the commutator before screwing it up. As this is done, test the insulation by grounding one side of the test box on the clamp, and then stepping entirely around the commutator, with the other side, touching it to each segment in succession. No short circuit being found, as above searched for, and the turning being finished, test all round the commutator, holding one contact on a segment the other contact on

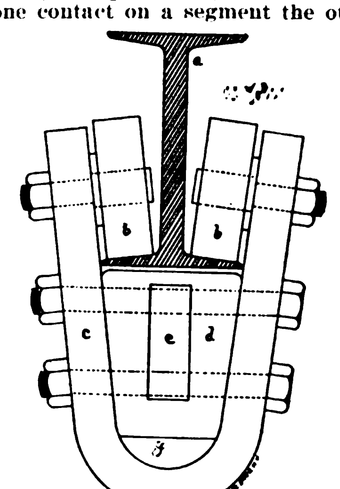


FIG. 8.

the next, then bringing the back contact ahead, and thus stepping clear around the commutator. Whenever a contact is found, search for it, and pick out the bit of copper with a sharp penknife or an awl.

Very little testing, during process of manufacture, is now done with Wheatstone bridge, or resistance box. And the magneto is not as much in evidence now as it formerly was. The tendency seems to be toward a 220-volt current or more for testing, and the use of incandescent lamps as a signal that there is a short circuit. A handy rig for the purpose is shown by Fig. 5, where a and b represent the leads of a three-wire system, giving 220 volts pressure as connected. A fuse box or

cut-out is placed at c, and in the shop where this device was noted, the workman disconnected one of the fuses before leaving the building at night. Regarding this precaution, he stated that it was a good deal easier to disconnect a fuse once or twice a day, than it was to build a new shop once.

His theory was that somebody might possibly go away and leave the switch, d, closed. Then, in case of accidental falling of the contacts, f and g, near any combustible matter during the night, there was possible the condition for a first-class fire. And the point was well taken.

One of the contacts is shown more in detail by Fig. 6. It consists of a steel wire, pointed as shown at d, and hardened like an awl, to stand a good deal of wear. A piece of rubber tube is slipped over the steel wire. The tube, e, is made fast by the rubber tape, f, to the wire, g, which connects the point with the source of current. The steel wire ought to be soldered to the copper lead, g, before it is taped.

Several "refinements" suggest themselves in connection with the danger from leaving current in this testing device. One of the schemes is to put a couple of contacts in each of the rubber-covered testing points, these contacts to be arranged in such a manner that they must be compressed or pinched by the thumb and fingers of both hands while in use, no current flowing when the contacts are not thus pressed, making it impossible for the testing points to do any harm when they come in contact when not in use, as no current can flow unless two sets of independent contacts are pressed all the time.

This will make things safe enough, but an element of unreliability enters the instrument when this is done, as the contacts might not be fully closed, and the lamps would not glow under such circumstances, even when two of the commutator segments were bridged over with a heavy piece of copper.

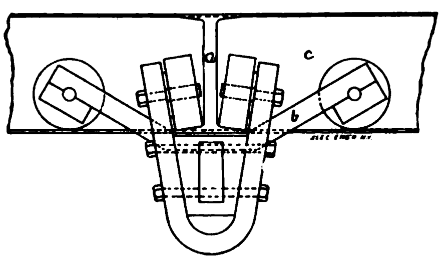


Fig. 9.

Otherwise, the safeguard would be an admirable one, and it is further suggested that a couple of colored lamps be so connected that they shall be lit at all times when current is available in the testing points and the contacts closed. Then a man would not test unless the red lamp was lit.

By another arrangement, the red lamps could be cut into the circuit shown in Fig. 5, and so arranged that they would glow when the switch, d, was closed, but would go out when the lamps, e, lit up, owing to the contact points being short-circuited. This would seem to make a pretty safe rig, as the fuse could be detached as at present, if desirable, and the red light would always be a reminder that the switch was closed.

Baking commutators is an important part of their construction. Steam heat hardly runs high enough to bake small commutators quickly enough, although it is used considerably for baking armatures. Steam will heat up to about 200 or 210 degs. F., and it gives a steady, even heat, but the gas-heated oven is given preference by those who have tried both steam and gas, and gas is convenient, and not very expensive, and also has the advantage of driving off moisture better than steam, for the reason that in a gas-heated oven there must be means for constantly introducing fresh air, and as the loaded heated air is driven off, it carries the moisture with it, while, when steam heat is used, the same supply of air remains dead in the oven, and the moisture stays there too.

Fig. 7 shows a very good form of gas oven. It may be made in any one of several ways, either by putting up a double sheet iron box, and filling between with asbestos, or by putting up a wooden box and covering the whole thing with stout tin. In the oven shown, it will be noticed that the whole thing is set up on pieces of wood, so there can be a circulation of air underneath. The air comes up through the bottom of the oven, the back part thereof being left open, as shown.

A gas stove, a, is placed in the oven, one of two, three, four, or even six, burners being used, according to the size of oven. The heat is controlled and graded by the globe valve, b, which regulates the gas supply to suit the work to be done. Shelves made of iron are put in, common cook stove grates being used in one oven of this kind. The oven represented in the engraving had a three-burner stove in it, and the oven itself was about 3 feet square and 3½ feet high.

A good many defects that come to light in armatures can be charged direct to bad handling during process of construction. It takes but a very slight knock to damage the insulation of a wire, or to drive a snag through some part of the winding in such a manner as to cause future trouble. One of the commonest causes of damage is during the putting of armatures into, and taking them out of, the lathe. No matter how small an armature may be, it should not be lifted into a lathe by hand, unless, indeed, it is so small that it can be easily held in one hand, while the lathe is adjusted with the other.

Use some form of overhead traveler, or a crane, if nothing better can be had. But a simple form of traveler, as shown in Fig. 8, consists of an I-beam, a, trolley wheels, b, b, which are set at an angle just right to make them run easily on the bottom web of the I-beam. A plain wrought iron strap, c, is bent up to the right angle to receive the trolley wheel axles, and the strap is held by bolts to a casting, d, which is mortised to receive the bar, e, which may be attached to a similar pair of trolley wheels if the work is heavy enough to warrant, but on light work, one set of wheels is sufficient, the hook for the chain hoist being attached at f.

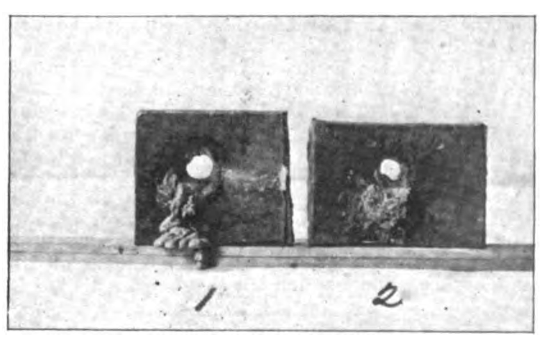
For some work it is desirable that the traveler have a movement lengthwise with, as well as crosswise of, the lathe, so that work can be moved right up to the centers, as well as merely swung into the lathe. For this purpose, a form of the traveler may used as shown in Fig. 9. This is the same kind of a trolley as was shown by Fig. 8; in fact, the same one may be used, another set of trolley wheels being fitted on at b, to run on the longitudinal I-beams, c, the hanger, b, being bolted to the I-beam, a, in such a manner that it runs on the lower flange of beam, c, exactly as the other wheels run upon beam, a. In this fashion a very stiff compound overhead traveler, of limited movement and capacity, is obtained very cheaply. Not only is it a simple form of construction, but it is likewise very stiff. A 4 or 5-inch I-beam will answer for almost any load that is likely to be put into a 15-inch lathe.

These travelers, or "lathe lifts," as they ought to be called, if taken in connection with trucks, or wheeled horses specially fitted to receive armatures, will effectually prevent damage while handling in the shop.

LETTERS TO THE EDITOR

SAFE BURGLING BY ELECTRICITY.

I HAVE been interested in the discussion which has been going on for the past few months about the possibility of using the electric arc in an illicit manner upon safe doors,



Perforations in Iron and Steel by the Electric Arc.

and the different opinions expressed pro and con by men held to be informed on electrical problems, led me to make a little private investigation myself and it did not take me long—only a part of one afternoon, to satisfy myself that it is as "easy as rolling off a log."

The enclosed photographs show two pieces of metal which I burned holes in at my first attempt; the one at the left is cast iron, the one at the right is the finest tool steel. Each piece was one inch thick. The hole in the cast iron was burned in less than one-half the time it took to burn the hardened tool steel and the time was so short I dare not tell it; nor do I propose to tell you, and, at the same time, the bank burglar, how it was done.

I will simply say that I used the wires I found in a mer-

cantile building using the Edison incandescent lighting circuit and that I carried everything I used in with me in a soap box. I stayed in a room about 15 feet square over two hours, using the current most of the time on different metals, and one window was up about 6 inches at the bottom; so much for the fumes, about which so much has been written. My "resistance" weighed less than 60 pounds; the current was said to be 110 volts, but what it may be I do not know or care. I used it for my purpose. No fuses were burned out and no one knew I was using the current for any such purpose.

I held the Edison carbon in my bare hand, simply wrapping my handkerchief around it. The metal melted at once and large globules ½ to ¾ inch in diameter ran out of the holes and cooling, touched and short-circuited on the carbon; but I made no attempt to clear them away; had I done so the time would have been shortened very materially. I would much rather burn a hole clear through 5 inches of steel with this current than try to burn 5 inches of oak with a red hot poker.

I consider the controversy settled and the only question that remains is, How are we to prevent it?

JAMES H. HOWARD.

Boston, Mass.

OBITUARY

HENRY B. STONE.

Henry B. Stone, ex-Vice-President of the Chicago, Burlington and Quincy Railroad, and ex-President of the Chicago Telephone Company, was killed at Nonquitt, Mass., July 5 by an explosion. Mr. Stone, with his family and other summer residents of Nonquitt, was celebrating the National holiday with a display of day fireworks. Among them was a bomb, which, when exploded, let loose paper animals of various colors. Mr. Stone had applied the torch to this piece, but it did not appear as if the spark was going to reach the mine. Mr. Stone advanced and took the piece up in his hands. It exploded, striking him full in the face. He dropped to the ground instantly killed. His features were badly mutilated, and he sustained a compound fracture of the skull.

He leaves a widow and four children. His remains will be sent to Chicago for interment.

PROF. DE VOLSON WOOD.

De Volson Wood, professor of mechanical engineering at Stevens Institute of Technology, Hoboken, N. J., died suddenly June 27. He was born near Smyrna, N. Y., in 1832, graduated from the Albany Normal School in 1853, and two years later from the Rensselaer Polytechnic Institute, Troy, and was appointed professor of civil engineering at the University of Michigan, which place he held for fifteen years. He then took the chair of mathematics of Stevens Institute, and later the chair of mechanical engineering, which he held at the time of his death. Prof. Wood was a member of the American Society of Civil Engineers, American Society of Mechanical Engineers and the American Association for the Advancement of Science, of which he was at one time vice-president. He was the first president of the Society for the Promotion of Engineering Education. He was the author of many text-books, which are in use at the principal technical colleges of the country and are authorities on higher mathematics and mechanical engineering. He was greatly liked by his pupils, many of whom are now filling places of distinction in the mechanical and electrical engineering fields.

LEGAL NOTES

STREET CAR MOTOR LITIGATION-GENERAL ELECTRIC CO. vs. WALKER CO.

Judge Putnam in the United States Circuit Court, Boston, on June 29 heard the bill in equity brought by the Thomson-Houston Electric Company vs. the Athol & Orange Street Railway Company. The plaintiff, as the owner of patent No. 448,260, granted to E. W. Rice, March 17, 1891, for an improvement in motor suspension, and of patent No. 470,817, granted to F. O. Blackwell, for an improvement in electric motors, brought this suit for an injunction to restrain the defendant from an alleged infringement of those patents. Both patents relate to different parts of an electric motor. The defendant uses the Walker motor, and it denies that it infringes upon the plaintiff's patents or that the patents are good.

F. P. Fish, J. J. Storrow and A. D. Salinger for plaintiff; C. E. Mitchell and H. B. Brownell for defendant.

TELEPHONE LITIGATION.

It is stated that Western Telephone Construction Company, of Chicago, have brought suit against the American Bell Telephone Company et al. for the alleged infringement of patent No. 581,350, taken out by Mr. J. E. Kellyn on a telephone receiver, now owned by the company first named.

INSOLVENCY SUIT AGAINST THE BEST TELEPHONE MFG. CO.

The John A. Roebling's Sons Company has filed a bill in Circuit Court No. 2, Baltimore, against the Best Telephone Manufacturing Company, of Baltimore city, in which it is asked that a receiver be appointed to take charge of the property and assets of the company, who would administer the property under direction of the court. Judge Wright signed an order that a receiver be appointed for the company unless cause to the contrary be shown before July 10, 1897.

It is alleged in the bill that the Roebling Company, in December, 1896, furnished the Best Company with goods to the value of $2,988.82, for which the latter has not paid. A suit for the amount is now pending in the Superior Court. The Best Company on June 23 denied the indebtedness under oath in answer to the case in the Superior Court. It is charged that it is false and is made to hinder the company from getting judgment. It is also charged the Best Company is insolvent and that it is necessary to have a receiver appointed to take charge of its assets.

SOCIETY & CLUB NOTES

THE ENGLISH ELECTRICAL ENGINEER VOLUNTEERS.

The corps of Royal Engineers (Volunteers) Electrical Engineers was suggested by a committee of the Institution of Electrical Engineers more than a year ago. The proposal was accepted by the War Office in a liberal spirit, and it is proposed to give important duties to the corps in connection with the defence of the defended harbors, and to treat it in regard to capitations and the like in exactly the same way as the Submarine Miners are at present treated.

The members of the corps will be placed under somewhat different conditions with regard to the requirements of the service from those of the rifle volunteers; for example, in the event of war they would be liable to be called out even though there was no fear of actual invasion.

The corps is intended to bring together a body of men having adequate knowledge of applied electrical science, and train them in the application of their knowledge to defence. The principal duty at present to be entrusted to the corps will be to undertake in connection with the home defence, to provide officers and men to assist the regulars in working defence electric lights at all defended ports, and, in particular, at certain ports of the first importance, where there is at present a deficiency of trained men. For this purpose, a certain number of electricians will be required, and a certain number of men accustomed to drive engines. In addition to this, it may be expected that the corps will have other duties in which electrical knowledge will be useful.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

We understand that the council of the institute at a recent meeting confirmed the action taken at the annual meeting in regard to the adoption of the new badge, and has decided that the number engraved on the back with the owner's name shall correspond with that on the institute roll; that is, be numbered consecutively in the order of their admission to the Institute.

Preparations are now being made for the general meeting at Greenacre, Me., and there is promise of a large attendance. A good list of papers and discussions has been secured.

CHICAGO ELECTRICAL ASSOCIATION.

On Friday evening, June 25, the members of the Chicago Electrical Association, accompanied by lady friends, accepted the hospitality of Mr. W. A. Harding, of the Calumet Electric Railway Company, in the form of an illuminated and spectacular trolley ride over the lines of that company. The evening was particularly fine, the preparations for transportation, illumination and entertainment were entirely complete, and the temper of the gathering was as full of vivacity as is usual with technical aggregations. At the close of the trip, after four hours' condensed enjoyment, vociferous cheers were tendered Mr. Harding and the Calumet Electric Railway Company, with a final for the association itself.

SYNOPSIS OF CURRENT ELECTRICAL LITERATURE

Dynamos and Motors:

AUTOMATIC STARTING AND STOPPING ARRANGEMENT FOR ELECTRICALLY DRIVEN PUMPS.—By Alfred Oppenheim. A short article with one very clear diagram, descriptive of such an arrangement. The action of the device is mainly dependent upon a float contained in the reservoir; the float rising and falling with the changing water level. The arrangement described is, however, particularly valuable because it (a) allows the motor to be started slowly and without a jerk, and (b) because it is almost independent of the size and voltage of the motor.—Zeit. f. Electrot., April 15, '97.

Electro-Physics:

ON A NEW KIND OF BLACK RAYS.—By E. Friedrich in Elbing. An article on those rays lying farthest beyond the violet end of the spectrum and which he terms black rays, because they require bodies of the most delicate susceptibility to light, to make them visible. Author states that the invisible rays are more intense the farther they lie beyond the light giving rays of the ether, i. e., beyond the ultra violet end of the spectrum. Author terms refraction the "Energy" of light, and then states that the vibration of light is inversely proportional to its refraction and since violet of the prismatic colors has the least number of visible vibrations it hence possesses of the seven "rainbow" colors the greatest energy or refractive power. Author proceeds to develop a new etiology of rays in conjunction with a new theory of the ether and of colors; based on the facts that only a yellow-green fluorescing glass wall can furnish black rays while a blue or violet fluorescing glass wall cannot do so and because fluorescence itself is really superfluous since also non-fluorescing bodies such as platinum-tin, for instance, furnish black ether rays which are more intense than those furnished from fluorescing glass walls.—Ztsch. f. Elektrot., April 15, '97.

THE EMISSION OF LIGHT.—An editorial comment on a paper by H. Kruss, published in the "Journal für Gasbeleuchtung," 1896, Vol. 39, p. 425. The results given are those of the researches of Lummer, Karlbaum and Wien on a suitable standard or unit of light emission and those of St. John on emissive powers of substances. Methods depending on melting point of platinum are unsatisfactory. Lummer and Karlbaum unit is amount of light emitted from 1 square centimetre of glowing platinum foil, heated by current from a secondary battery. Temperature is fixed by an interesting absorption method. In this element the unit can be fixed to an accuracy of 1 per cent. St. John makes comparative determinations between brightness of a hot platinum surface and that of same platinum coated with a metallic oxide at the same temperature. Platinum temperature 1,200 degs. C. Taking the brightness of the plain platinum foil for a given wave length as unity, that of other surfaces was only found to vary from 0.987 in the case of didymium oxide to 1,017 in the case of lanthanum oxide. It is stated that the fact that the rare earths investigated, behave in accordance with Kirchhoff's law is fatal to the suggestion which has been made, that they have a specific luminosity or power of emitting, in the form of light, a part of the energy absorbed in the formation. The emissive power of platinum taken as unity, that of lanthanum oxide is found to be 2.15 and that of zirconium oxide as high as 3.15.—Lond. "Electrical Review," May 14, 1897.

ON THE MAGNETIC CHARACTERISTICS OF THE NEWER KINDS OF IRON AND THE STEINMETZ CO-EFFICIENT OF MAGNETIC HYSTERESIS.—By Dr. A. Ebeling and Dr. Erich Schmidt. This article embodies results obtained from experiments at the Reichsanstalt. Part I. tends to show that cast steel of high magnetic value is now being generally produced; while Part II. treats of the Steinmetz co efficient of magnetic hysteresis. From the tables given in the first part the authors find the fact verified that a magnetic material is not defined by one only of the quantities hysteresis, permeability, coercive force, etc., because two materials may coincide exactly in respect to any one of these quantities, and yet differ entirely in respect to the others. In their determination of magnetic homogeneity or non-homogeneity, the authors find the method of electric conductivity to be the simplest, the variation of which is determined along a so-called test-bar. It is stated that in every case the results obtained show that electric and magnetic homogeneity are coexistent attributes. In Part 2 it is stated that according to Steinmetz the factor should for the same material be independent of the chosen value B. They find, however, that if the different values of n are calculated for the values B 1.6 and E determined by Steinmetz, considerable variation is observed. In one table they show such a variation of more than 20 per cent., and they quote Steinmetz to the effect that the variation will in reality be still greater.—"Electrotechnische Zeitschrift," May 13, 1897.

Motor Carriages:

MOTOR TRAFFIC: TECHNICAL CONSIDERATIONS.—By Sir David Salomons, Bt. A paper read before the Society of Arts, May 12, 1897. A popular article which, however, contains valuable suggestions to motor carriage builders, particularly, as to the use of springs, rubber and pneumatic tires, etc. The electric motor in respect to its use on vehicles is thus summarily disposed of. "The electro-motor offers certain advantages, inasmuch tnat it is easy to stop and start, for accumulators possess a reserve power similar to the steam engine, but may be at the risk of wearing the accumulator. Of course, if larger electro-motors or other forms of engines were carried than are necessary, some of the difficulties pointed out would be greatly reduced, but practical consideration, such as expense, great additional weight, bad economy in working bar such a procedure,"—"Industries & Iron," May 14, 1897.

Miscellaneous:

EXPERIMENTS UPON PROPELLER VENTILATING FANS, AND UPON THE ELECTRIC MOTOR DRIVING THEM.—By William George Walker. First installment of a paper read before Institution of Mech. Engrs. Author refers back to a paper of his read in 1892, describing experiments on the arrangement of the surface of a screw propeller; and to some experiments made with air propellers in order to try the effect of the thickness of the blades. In the present paper he describes experiments made with a view of ascertaining (1) whether this kind of fan follows the ordinary laws respecting the mutual relations of speed of fan, power absorbed, and amount of air discharged; (2) the general characteristics regarding the speed of fan, power absorbed, and quantity of air discharged, with different angles of the blades; (3) the effect of fans differing from one another only in the cross section of their blades. Author states that experiments on the propeller ventilating fans showed that the relations of speed of fans, power absorbed and air discharged are in accordance with the ordinary laws. The experimental apparatus consisted of seventeen three-bladed fans, all 22¾ inches in diameter, especially constructed for these experiments. A table showing the various sections is given. The fans were driven by a 1-3 horsepower motor. All the results given in the paper are with fans having a free discharge, the outlet being practically equal in area to the inlet of the fan. The air was delivered through a sheet iron tube 24-inch bore and 4-inch long. Elaborate tables of the experimental results are given.—London "Electrical Engineer," May 14, 1897.

THE INFLUENCE OF SYNCHRONOUS MOTORS ON THE POWER FACTOR OF POLYPHASE CURRENT CENTRAL STATIONS.—By R. Klasson. A series of tabulated experiments, made at the power house of the imperial powder factory at Ochta near St. Petersburg by the author, with the object of modifying the troublesome lag produced in a polyphase generator circuit supplying many lightly loaded synchronous motors. The polyphase circuit of the powder factory shows during the day an exceedingly low power factor, namely, 0.6 to 0.65, this being due to the fact that during the day, motors exclusively are run from its lines. To decrease the lag the author experimented with the introduction of a synchronous motor on the lines and found the efficiency of the generator was thereby greatly increased, while the line loss

(other things being equal) was greatly diminished.—"Electrotech. Zeits.," May 13, 1897.

Power Transmission:

THE ALUMINUM WORKS AT FOYERS.—A descriptive and well illustrated article on the aluminum works erected on the banks of Loch Ness near Inverness below the Falls of Foyers. The Foyers fall is one of 350 feet, while Niagara has but 120 feet and Neuhausen on the Rhine only 65 feet. Water is taken from the River Foyers, three-quarters of a mile above the factory passing here into the first intake and flowing through a tunnel half a mile in length to the penstock chamber, where it passes down six lines of pipes to the turbines. The tunnel is remarkable for being straight for its entire length, there being not more than a foot drop from one end to the other, the great fall of water being obtained in the pipes between the last penstock chamber and the factory. When the water supply arrangements have been completed the water storage will be equivalent to 3,600,000,000 gallons. Each turbine is designed for 700 brake horse power at 140 r. p. m., with a 350-feet fall. Diameter of turbines from one side of vanes to the other about 10 feet. Vertical shaft is of steel 8 inches in diameter and runs in a step bearing. Armature on its upper end weighs 14 tons. Turbines were built by Escher, Wyss & Co., of Zurich; dynamos by the Maschinenfabrik Oerlikon. Magnet frames are of soft cast iron supported by iron columns. There are 24 poles on each machine. Winding of armature is multipolar drum. Commutator which is 6 feet in diameter has 216 segments; 120 brushes are employed. Lighting plant consists of a small lighting dynamo driven by a Pelton wheel. At present four generators are used for aluminum purposes, the fifth for calcium carbide.—London "Electrical Review," May 14, 1897.

Telegraphy, Telephony, Etc.:

RAPID CABLE LAYING FOR WAR PURPOSES.—By Lieut. Crutchley, R. N. R. & C. Scott Snell. Paper read before Royal United Service Institution, April 28, 1897. Describes a method whereby a submarine cable can be safely laid at any rate of speed within the compass of the fastest cruiser. It is thus made possible for a naval commander in chief to have at his disposal the means of establishing telegraphic communications with an outlying picket of ships at a distance of 300 to 500 miles at the speed of the fastest warships yet constructed. The paper is well illustrated, the mechanical contrivances are carefully described and the method fully explained.—London "Electrical Review," May 14, 1897.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 22, 1897.

Alarms and Signals:—

BURGLAR ALARM. H. M. Sutton and W. L. Steele, Dallas, Tex., 584,798. Filed October 29, 1895.
Provides means for alternating the current at frequent intervals, and at the same time changing or shifting the current automatically from one set of lines to another.

AUXILIARY FIRE ALARM SYSTEM. R. E. Alexander, Yonkers, N. Y., 585,072. Filed October 31, 1895.

ELECTRICAL ALARM FOR DOOR LOCKS. P. V. Vandevelde, Corona, N. Y., 585,138. Filed April 6, 1897.
Details of construction.

Conductors, Conduits and Insulators:—

COMBINED BRACKET AND INSULATOR. G. W. Mead, Shellsford, Tenn., 584,823. Filed December 21, 1896.
A combined bracket and insulator screwed into the support, and a brace connected to the support and the bracket.

ELECTRIC CONDUCTOR. I. W. Henry, New York. 584,936. Filed September 15, 1896.
A submarine conductor comprising a conducting core inclosed within a sheath of waterproof insulating material, an inclosing sheath of fibrous material, and an armor composed of non-magnetic wires side by side.

TIELESS INSULATOR. R. Delery, New Orleans, La., 585,026. Filed January 11, 1897.
The wire is held by screwing between a two-part insulator.

Dynamos and Motors:—

BRUSH HOLDER FOR DYNAMOS. J. H. Yearsley, Philadelphia, Pa., 584,912. Filed April 8, 1897.
Details of construction.

Electro-Metallurgy:—

APPARATUS FOR ELECTRIC THERMAL TREATMENT OF METALS, ORES, ETC. G. D. Burton, Boston, Mass., 585,019. Filed November 30, 1896.
Devices for maintaining, directing and regulating the flow of a stream of an electrolytic solution; also for maintaining the solution at the required heights in the tanks and wells; also for supporting the articles to be acted upon and for supplying them with the required electric currents.

METHOD OF MELTING IRON BY ELECTRICITY. C. G. P. De Laval, Stockholm, Sweden, 585,040. Filed October 3, 1892. See page 747, June 30, 1897.

APPARATUS FOR ELECTRODEPOSITION OF METALS. A. S., T. A., R. J. and S. Smith and T. Deakin, Walsall, Eng., 585,051. Filed August 27, 1896.
The articles to be treated are placed within a revolving barrel, supported within the electrolytic bath, and during the time that the deposition of the metal is taking place, subjected to a rolling over and over, or shaking process, which completely polishes brilliant their surfaces.

Lamps and Appurtenances:—

ARC LAMP CARBON. T. M. Foote, Chicago, Ill., 584,867. Filed February 17, 1896.
The carbon has a groove or slot from the circumference to the center, running its full length.

ELECTRIC ARC LAMP. A. Bureau, Brussels, Belgium, 584,983. Filed January 27, 1897.
Details of arc lamp mechanism.

MULTIPLE FILAMENT REGULATING INCANDESCENT LAMP. C. Truitt, Columbia, Mo., 585,137. Filed February 15, 1897.
A socket so arranged that by rotating the lamp, one filament is cut in after the other.

Miscellaneous:—

ELECTROMAGNET. C. P. Bostian, Milton, Pa., 584,848. Filed April 22, 1897.
Uses a core having perforations therethrough and inserting in the perforations insulated soft iron rods.

THERAPEUTIC ELECTRIC CURRENT GENERATOR. E. W. Chellis, Erie, Pa., 584,853. Filed May 5, 1897.
A spring-driven magneto, in a pocket case, wound like a watch.

ELECTROTHERAPEUTICAL APPARATUS. F. J. Patten, New York, 584,957. Filed September 30, 1896.
Designed to lessen the shock of the current.

VALVE APPARATUS F. Gray, Chicago, Ill., 585,094. Filed January 4, 1897.
An electrical circuit maker or breaker is employed to automatically open or close the circuit for any given purpose or the momentary pressure is relieved without opening the valves fully. For use in conjunction with automatic fire sprinkler systems.

Railways and Appliances:—

TROLLEY. W. J. Smith, Gloucester City, and W. G. Johnston, Woodbury, N. J., 584,831. Filed August 5, 1896.
A self-oiling trolley wheel, and other details of construction.

ELECTRIC RAILWAY. F. W. Hunter, Cranford, N. J., 584,873. Filed November 17, 1896.
Employs the rails as the return and two parallel conductors of similar polarity within the conduit disposed relatively to each other and to the slot of the conduit that they come upon either side of the vertical plane dropped down from the slot.

ELECTRIC RAILWAY SYSTEM. G. Westinghouse, Jr., Pittsburg, Pa., 584,911. Filed November 26, 1892.
The trolley is a cylinder having a number of grooves. The trolley wire has yielding supports.

ELECTRIC RAILWAY TROLLEY. E. M. Bentley, New York, 584,918. Filed June 4, 1896.

CONDUCTOR FOR UNDERGROUND ELECTRIC RAILWAYS. C. Peterson, San Francisco, Cal., 585,047. Filed January 29, 1897.
Consists in the novel construction of concaved insulated conducting plates arranged longitudinally within a tunnel, so as to form contacts for trolleys connected with the car.

INSULATED SUPPORT FOR CONTACT RAILS. A. Hanson and J. R. Chapman, Chicago, Ill., 11,613. Reissued. Filed March 24, 1896.

Switches, Cut-Outs, Etc.:—

AUTOMATIC SWITCH FOR ELECTRIC CIRCUITS. R. Belfield, London, Eng., 584,843. Filed June 19, 1895.
Automatically operates whenever the current in the controlling circuit becomes either greater or less than a certain predetermined value. The further object is the provision of a method whereby either the primary or the secondary of a transformer in a distant station may be instantly cut in or out.

CONTROLLER FOR ELECTRIC MOTORS. H. P. Davis, Pittsburg, Pa., 584,856. Filed October 28, 1896.
Details relating to an elevator controller.

MAGNETIC CIRCUIT BREAKER. W. E. Harrington, Philadelphia, Pa., 585,030. Filed December 26, 1895.
The cut-out switch is actuated to sever the connection of the circuit with a rapidity bearing an inverse ratio to the amount of excessive current flowing through the circuit.

Telephones:—

TELEPHONE TRANSMITTER. R. S. Barnum, Chicago, Ill., 584,810. Filed July 9, 1896.
Special construction to avoid packing.

TELEPHONE-ANNUNCIATOR, CALL-BELL and FIRE-ALARM. M. Garl, Akron, Ohio, 584,819. Filed April 6, 1895.
Details of construction.

TELEPHONE. J. T. Gent, A. W. Staveley and I. H. Parsons, Leicester, Eng., 584,868. Filed December 11, 1895.
The microphone is rotated when the receiver is removed from the hook, to prevent packing.

TELEPHONE BRACKET A. Y. Gordon, Masillon, Ohio, 584,871. Filed November 27, 1896.
Details of construction.

PERSONAL

MR. A. C. SHAW, business manager of The Electrical Engineer, sailed for Glasgow on July 3, by the City of Rome, for a short holiday.

MR. R. T. LINCOLN has been elected president pro tem. by the Chicago Telephone Company, as successor to Mr. H. B. Stone.

MR. W. A. JACKSON, who has been vice-president and

general manager of the Central Union Telephone Company, has been elected its president. As a pioneer telephonist he is well known throughout the electrical field.

PRESIDENT INSULL, of the National Electric Light Association, was in New York City last week on important business in connection with its work.

MR. F. C. PHILLIPS, under whose wise and able management the Elwell-Parker Electric Company, of Cleveland, has been slowly but surely coming to the front, was a busy visitor to New York last week, staying over the Fourth.

MR. F. H. WEBB, on his retirement from the secretaryship of the London Institution of Electrical Engineers, was given a complimentary dinner at which Lord Kelvin presided.

MR. JAMES F. HEYWARD, general manager of the City and Suburban Railway, Baltimore, will, on July 6, become assistant to the president of the United Traction Company of Pittsburg, Pa. He will retire from his present position on July 1, when all the duties of that office will be handled by Vice-President and General Manager House, of the Consolidated Railway, formed by the consolidation of the City and Suburban and the Traction Company. Mr. Heyward was elected secretary of the Consolidated Railway, but owing to his active disposition and experience in the operating department, he considered the duties uncongenial and resigned.

THE STOCK MARKET

GENERAL STEADINESS.

BUSINESS was interrupted more or less during the past week by preparations for the long holiday around the Fourth, and will not again resume normal activity till the summer vacations are over; but there is no change in the general sentiment of confidence and steadiness developed before the month began. Even with a large strike threatening in the coal industry, values have not gone off at all, whereas a short time ago, the mere rumor of it would have sufficed to render everybody nervous and depressed. The country has gone through too much to worry about a little thing like that.

Of Western Union last week there were sold 37,276 shares at prices up to 85. General Electric sold to the extent of 12,340 shares up to 35. American Bell is not selling in large blocks, but stays easily around 230.

COPPER is quoted at 11½ Lake, and 11¼ Western, firm.

STEEL RAILS, heavy section, are quoted $19 and upward; light rails, $24 to $28.50.

MAGNOLIA METAL quotations are furnished us as follows: Magnolia anti-friction metal, 25c. per lb., f. o. b. N. Y. or Chicago; No Name metal, 18c. per lb., f. o. b. N. Y. or Chicago; Mystic metal, 8c. per lb., f. o. b. N. Y. or Chicago.

TRADE NOTES & NOVELTIES

WESTINGHOUSE PLANT FOR THE SOUTHERN UNION DEPOT, BOSTON.

Although it is only a week since the Westinghouse Electric and Manufacturing Company made the announcement that they had obtained an enormous contract of power transmission apparatus for fifteen 5,000 h. p. generators from the St. Lawrence Construction Company, of New York, the Westinghouse people have now secured another order for electrical apparatus which, while not so large, is of equal importance. This is a contract from the Boston Terminal Company, which is now constructing the Southern Union Depot, at Boston, Mass. It is the intention of the managers of the new Union Depot not only to handle the largest number of trains entering any station in the world, but to handle them in the most complete and efficient manner.

All the modern devices of interior motive power for heat, light, electric power, signaling, elevator work, refrigeration, ventilation, etc., will be taken advantage of in the equipment of this gigantic undertaking and the Westinghouse interests have obtained the entire contract for doing all this work. In this fact lies the most important feature of the contract because it was found by the management that it was necessary in order to obtain uniform work to put the entire matter into the charge of one firm; and as the Westinghouse interests as manufacturers of steam engines, electrical machinery and signaling apparatus were the only firms bidding for this work in a position to undertake it all, the management of the Terminal Company decided for that reason to entrust the Westinghouse Companies with the work. In this connection President Charles P. Clark, of the New York, New Haven & Hartford R. R., says: "We awarded the contract to the Westinghouse Companies because they are the only concerns that cover the whole field. Any subdivision for the engineering of construction the company will attend to, and thus it should be able to connect and centralize all the heat, light and power economically. We expect to be in the new Union station in 1898."

It is understood that this contract amounts to over half a million dollars. The whole contract was made directly with Westinghouse, Church, Kerr & Co.

BALL ENGINES IN THE LIGHTING FIELD.

One of a comparatively few strictly high grade engines for electrical purposes is the Ball automatic engine, built by the Ball Engine Company, Erie, Pa. This engine's beginning was almost identical with that of the electric light business, and there are many stations where Ball engines that have been running from ten to fifteen years are giving good satisfaction to-day. The present management, with the experience of fifteen years building engines for electrical purposes, have brought the engine to the highest degree of perfection, and we are glad to learn that the extensive works of this company are very busy. In addition to their extensive business all over this country, they are shipping a number of engines to foreign countries.

MR. C. A. COFFIN ON THE SITUATION.

In a recent interview, Mr. C. A. Coffin, of the General Electric Company, said: "I am not a boomer, but I do know that our own business reflects very accurately the condition of the country. A year ago we were suffering, as were most manufacturing enterprises, from disturbed political and financial conditions. Now we are actively employed in every department, and our business is growing. My idea is that recovery is slowly but surely coming. The recovery will be substantial and solid. I can tell this in part from the volume and character of our purchases. We consume great quantities of copper, iron and rubber. These, in the order named, are the materials of which we use the most. Our purchases of each of them are far larger than they were a year ago. There is more money in circulation every day. Capital is coming out, ready for investment. Labor in all its branches is finding paying employment.

"In my opinion the certainty that Congress is going to pass the tariff bill has lent a great impetus to business. The settlement of the tariff for a good long time to come will enable business to adjust itself to conditions that may be considered as comparatively certain. As soon as the tariff bill is passed I think that Congress should adjourn and go home."

TARIFF ON LAMPS.

The schedule on incandescent lamps in the new tariff bill now in the United States Senate places the duty at 35 per cent. ad valorem.

BELL TELEPHONE OUTPUT.

The instruments statement of the American Bell Telephone Company for the month ended June 20, shows: Gross output, 17,586; returned, 7,998; net output, 9,588. From December 21 to June 20 the showing was: Gross output in 1897, 111,919, against 114,094 in 1896; returned, 44,606, against 43,177; net output, 67,313, against 70,917; total outstanding 839,602, against 745,983 in 1896.

NEW ENGLAND NOTES

PRESIDENT EUGENE PHILLIPS, of the American Electrical Works, has issued his usual memento of the Fourth in the shape of a beautiful edition de luxe of the Star Spangled Banner, in colors, with a picture on the cover of the flag waving over the fort in the morning light.

THE WILLARD AUTOMATIC sectional third-rail system described elsewhere in this issue is being placed on the market by the Willard Third Rail Company, of 34 School street, Boston, Mass.

MR. J. ORNE RYDER, Salem, Mass., notifies us that he has severed his connection with the Crown Woven Wire Brush Company, of that place, and has resigned as secretary and treasurer, so that he will have no further interest in the company.

NEW YORK NOTES.

MR. T. J. MONTGOMERY, of the T. J. Montgomery Company, Fulton street, New York, has sailed for England. He will look into European conditions in the tool and machinery trade. A large demand for their beautiful and useful publication, "The Tool Catalogue," has sprung up all over the world.

DALE MANUFACTURING COMPANY, Greenwich street, are sending out their new catalogue, of which they have issued 20,000. The book shows artistic designs of their latest productions in gas fixtures. The catalogue shows Dale Manufacturing Company's entire line and will be sent to any address upon application.

MR. M. R. RODRIGUES, 17 and 19 Whipple street, Brooklyn, N. Y., has issued a neat little folder giving some useful elementary data as to electricity and the use of batteries and motors.

A NEW TELEPHONE SHOP is to be built on Gold street, this city, by the New York Telephone Company and Robert Goelet. It will be eight stories brick, and will cost $175,000.

STATEN ISLAND.—The New York and Staten Island Electric Company are erecting at Livingston, Staten Island, a new power house of modern construction. The walls of the building are brick and the roofs have steel trusses covered with corrugated iron. The roofs are arranged with suitable monitors with skylights for light and ventilation. On the building is a large wire tower of steel construction. The engine room is arranged for a traveling crane of 15 tons capacity. The building has been constructed with the idea of having it absolutely fire-proof and arranged in an up-to-date manner. The roof of the engine and dynamo portions of the building is lined underneath the corrugated iron with the Berlin Iron Bridge Company's anti-condensation fire-proof roof lining. The Berlin Company have the contract also for furnishing and erecting all the steel framework and covering for the plant.

PIERCE & MILLER ENGINEERING COMPANY.—Mr. Frank M. Pierce, president of this company, informs us that on June 12, 1896, before starting on his trip around the world he purchased from J. D. Miller the small stock interest he then held in the company, and that Mr. Miller is no longer connected with the company.

WESTERN NOTES

H. M. UNDERWOOD & CO., the Marquette Building, Chicago, state that the factory where their lamp guards are manufactured was burned on the 28th ultimo. This was very unfortunate as a stock of 200 gross of the guards which were ready for shipment, as well as all the tools and machinery used in their manufacture were destroyed, and Mr. Underwood further states that he does not expect they will be able to fill any orders for two or three weeks. The firm will not sustain any loss by the fire outside of the delay which they will be put to in supplying their orders.

THE F. AND L. FLUSH PUSH BUTTON SWITCH is the Electric Appliance Company's latest specialty. This switch is a very simple and compact device, the size of the face plate being no larger than an ordinary two button gas key. The face plate is nickel plated with pearl buttons. One of the merits of the switch is the ease with which it is operated. The Electric Appliance Company are enabled to offer it at even a lower price than the regular snap flush switch. It is at present made only in single pole style, with a capacity of 5 amperes, although other sizes and capacities are now in preparation.

THE WILLARD ELECTRIC AND BATTERY COMPANY, of Cleveland, O., having had such great success with the Willard type of storage battery, are now placing on the market a new concentric accumulator which is very light in weight and especially adapted for horseless carriages, and which is also moderate in price.

MR. C. H. WILMERDING, with a competent staff, has taken up the management of the Crocker-Wheeler Co.'s business in this territory, his offices being in the Old Colony Building. His knowledge of electrical affairs in Chicago and the West makes him a very useful man, while his professional position guarantees the highest quality of service and results.

PHILADELPHIA NOTES

THE BALL ENGINE COMPANY, Erie, Pa., is building two 125-horse-power horizontal tandem compound engines, which will be used for the electric transmission of power and light in a large works in the city of Moscow, Russia.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXIV. JULY 15, 1897. No. 480.

MISCELLANEOUS.

THE TESTING OF AUTOMATIC MAGNETIC CIRCUIT BREAKERS.[1]—I.

BY C. M. CLARK and C. W. MACMULLEN.

SAFETY devices have long been essential elements of electric light and electric power systems, and among these instruments, the circuit breaker occupies a most important place. Its function is to interrupt the circuit, when the current in that circuit has risen to such an abnormal amount that it threatens to injure or to burn out the instruments or the conductors.

The first practical method of breaking the circuit was by means of a fuse. The following inherent faults of fuses have militated against their success: 1. Deterioration caused by (a) Recurring abnormal currents; (b) Oxidation from various causes. 2. The ability of the fuse to carry current in excess of its rated capacity, for a time sufficient in some cases to cause damage to conductors and apparatus. Another objectionable feature of fuses is the trouble of replacing those that are burned out.

In the automatic magnetic circuit breaker these faults are lessened and in some cases eliminated. Its most important features are: 1. Time element, i. e., the time of opening the circuit decreases as the conditions approach a short circuit. 2. Positiveness in opening. 3. Constancy and accuracy.

The current rises to a considerable strength in the case of

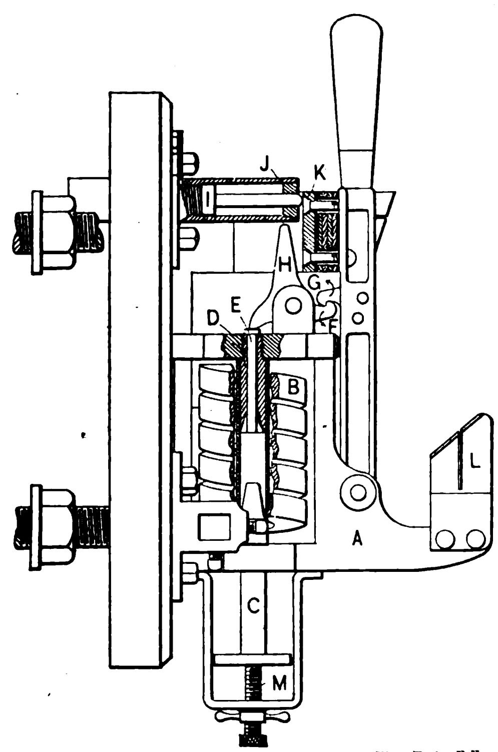


FIG. 1.

an overload on the circuit breaker, before the instrument acts. In most cases, however, a certain time element or capacity for heat is desirable, because the conductors and apparatus also have heat capacity, and it is not necessary to break the circuit if the current only momentarily rises above the normal.

On acount of these valuable features, the magnetic circuit breaker has steadily grown in importance, and has, in many cases, replaced the fuse. Data relating to the practical working of these instruments will be of value to those engaged in the application of electricity to light and power. It is for this reason, therefore, that the following investigation was undertaken. The circuit breakers tried in this test were of the well known I. T. E. type, made by the Cutter Electrical and Manufacturing Company, of Philadelphia.

This circuit breaker acts on the solenoid principle. The main current of the circuit passes through a coil of low resistance, B, Fig. 1. When the current has risen to a specified value, the movable plunger, C, is attracted up into the coil,

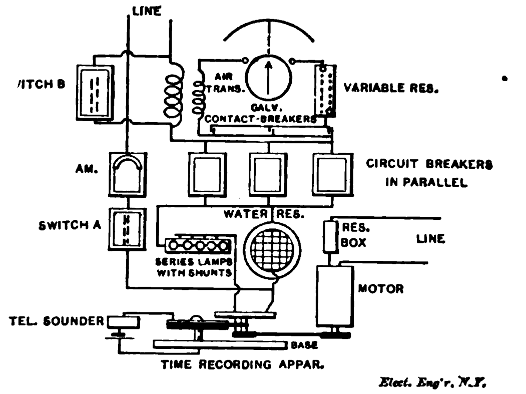


FIG. 2.

impinging against the "striker pin," E. This pin actuates the striker plate, which, in turn, releases the catch, G, of the switch arm. At the same time the switch arm is forced out by the spring piston, I, thus breaking the circuit. This instrument may be set to act at any stated current, within its range, by adjusting the screw, M, until the plunger is in the required position.

Our method of experimenting may be described by the following specific example. The circuit breaker is set at 15 amperes, i. e., it will break the circuit, when the current in that circuit rises to 15 amperes, approximately. Now, let a current exceeding 15 amperes by a certain definite amount be imposed on this circuit. It is required, first, to find how high the current rises above the set value of 15 amperes, and; second, to find the length of time taken by the circuit breaker to act.

The determination of these two values, the maximum strength of current and the "time factor," was the object of the following tests. Three sets of readings were taken for each setting of the instruments. In the first set of readings the current imposed on the circuit was so adjusted as not to exceed an overload of 50 per cent. in excess of that for which the instrument was set. In the second series of readings the overload was not allowed to exceed 75 per cent., and in the third set of readings there was practically a short circuit. By applying this method of reading to every setting of the instrument, values for the maximum current strength and "time factor" were obtained.

Apparatus for Determining Maximum Strength of Current. —In this apparatus the principle of mutual induction was utilized. The primary coil of an air core transformer was introduced into the main circuit, in series with the circuit breaker. The magnetic field produced by the current in the primary coil is proportional to the current. Now, when the field of the main current is building up, the lines of force of this field cut the secondary coil, inducing in it an e. m. f. proportional to the variation of the lines of force, and causing a deflection of the galvanometer. Since the variation of the lines of force of this field is proportional to the current in that circuit, by placing a ballistic galvanometer with large period of vibration in series with the secondary coil above mentioned and properly calibrating it, a reliable method for determining the maximum strength of the current by the deflection of the galvanometer was obtained. This method was suggested by Dr. M. I. Pupin.

Calibration of the Galvanometer.—Known currents, differing in strength, were successively impressed on the primary circuit, and the deflections due to each were recorded. These currents were chosen with reference to the range of action of the circuit breakers tested. Definite resistances were added to the galvanometer circuit, when necessary, in order to keep the deflection within reasonable limits.

[1]Graduation Thesis, Columbia University., 1897.

When the tests for determining the current strength were made, the added resistance in the galvanometer circuit was made the same as the resistance in some particular one of the calibration tests. By this means a direct proportion was obtained between a known current with a known deflection, and an unknown current with a known deflection. The solution of this proportion gave an accurate indication of the maximum strength of current in the primary circuit under any specified conditions.

Apparatus for Determining the "Time Factor."—The apparatus for determining the time factor consisted of a wooden disc revolving in suitable bearings, and driven by a small motor. The upper surface of this disc was covered with a layer of tin foil. On the tin foil was placed a circular piece of blotting paper of the same diameter. The blotting paper had been previously soaked in a solution consisting of 1.5 oz. red prussiate of potash, 0.75 lb. nitrate of ammonia, 0.5 lb. chloride of ammonia, and 1 gallon of distilled water. Part of the main current was shunted and made to pass through the chemically prepared paper, as it revolved. This was made possible by means of a sliding contact shown in the accompanying diagram, Fig. 2. The sliding contact was a thin iron rod, which pressed against the revolving disc—iron being a necessary factor in the chemical reaction which takes place on the passage of the current. The current in the shunt, passing through the chemically prepared paper, decomposes the compound at its point of contact with the iron rod, forming Prussian blue. When the disc revolves, and the current is allowed to flow, a blue circle is traced on the paper. The speed of the disc was so adjusted with respect to the duration of the current that an arc of the circle was produced on the paper.

The radius of the circle of which this arc formed a part, was carefully measured; the length of the chord belonging to the arc was also carefully determined. The speed of the disc was obtained in the following manner: A rubber belt was passed from the shaft on which the disc revolved, around a wheel whose diameter was so much larger than the shaft, as to make it revolve at 1-16th the speed of the disc. The time during which this wheel made a certain number of revolutions was taken, and by proper calculations the speed of the disc was obtained.

The stretch of the rubber band would have introduced an error had not the load on the shaft been inappreciable. The speed of the disc, the length of the chord and the radius of the circle being known, an accurate determination of the time factor was obtained. With properly constructed apparatus the time can be measured to within one-ten thousandth of a second, with a fair degree of accuracy. The methods here described were first applied to a carbon contact circuit breaker of the standard switchboard type, shown in the accompanying diagram. The range of this instrument was from 15 to 40 amperes. Its resistance was found to be 0.05 ohm.

Description of Circuits.—As shown in the diagram, the current from the dynamo first passes through the air core transformer, then through the circuit breakers which are arranged in parallel, so that any desired one may be placed in the circuit. From the circuit breakers the current passes to a water barrel resistance, and thence through a switch and ammeter, A, back to the dynamo. Shunted around the water barrel is a circuit which is used to determine the time. This current passes through an iron rod which presses on the chemically prepared paper. A series lamp board is used in this circuit to alter the resistance as desired. The paper is placed on the revolving disc which is covered with tin foil, thus completing the circuit as indicated by the dotted lines.

From the above mentioned disc, a similar disc is rotated by reduction gearing, and in connection with this a battery circuit with sounder, a sliding contact completing the circuit. Thus, the revolutions of the disc can be counted. The speed of the motor was regulated by the variable resistance, as shown in the diagram. A switch, B, was used to shunt the air transformer, to protect it from overheating, when it was necessary to have quite a large current on for some time during the setting of the different instruments.

The galvanometer circuit includes a large number of turns on the air transformer, contact breakers and a variable resistance.

A contact device was placed on the handle of the circuit breakers by means of which the galvanometer circuit was opened just prior to the interruption of the main circuit by the circuit breakers. This was necessary; otherwise a large "back-kick" by the galvanometer would be obtained.

Since the curve representing the rise in current is very flat near the top, any slight error in breaking the galvanometer circuit too soon, would make only a very slight error in the results. In making the experiments, the "contact breakers" were very carefully adjusted so as to avoid a "back-kick."

The function of the variable resistance was to make the deflection of the galvanometer about the same, no matter what strength of current passed through the transformer. We see, by this arrangement, that the galvanometer deflections are proportional to the lines of force produced by the primary circuit, which, in turn, are proportional to the maximum strength to which the current (in the primary circuit) rises.

The resistance of the "water barrel" was arranged so that the desired current would flow through the circuit, the strength being read by means of the ammeter. Everything being ready, the switch, A, was opened, and when the galvanometer was at rest, the circuit was closed by means of the switch, A, and the maximum swing of the galvanometer was noted; readings of the ammeter being then taken to see that the conditions of the circuit had not changed. This was repeated with different strengths of currents, the resistance of the galvanometer circuit being changed to correspond.

STORAGE BATTERY ENGINEERING PRACTICE.—XVII.

BY JOSEPH APPLETON.

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STORAGE BATTERIES IN EDISON STATIONS—(Continued).

THE cell regulating switches are illustrated in Fig. 66. There are four of these switches in all, arranged in two pairs on each side of the three-wire system. Each switch has thirty contacts with a carrying capacity of 2,000 amperes. The

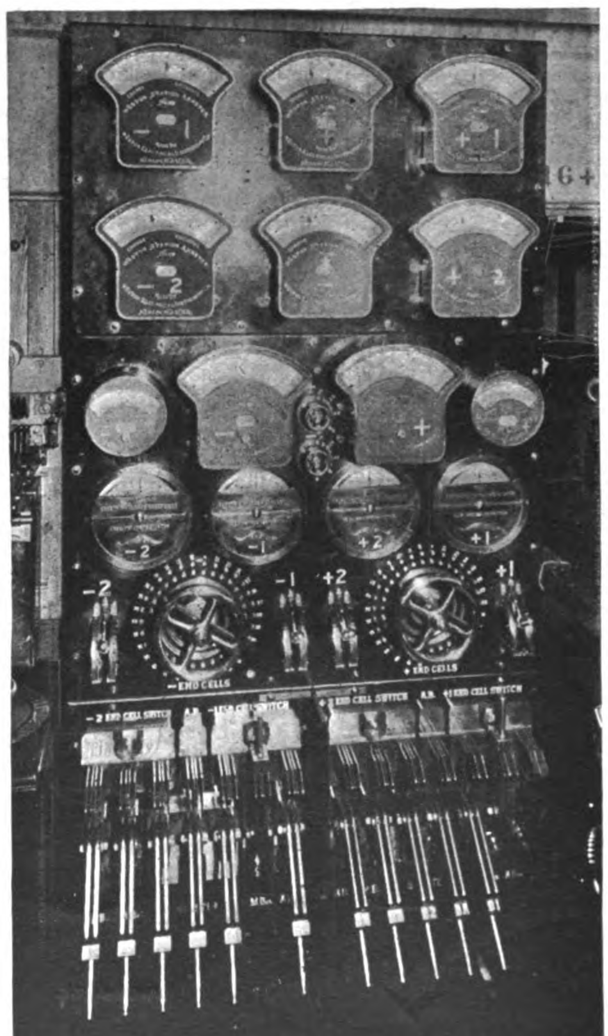


FIG. 67.—BATTERY SWITCHBOARD PANEL, PHILADELPHIA EDISON STATION.

general design of these switches is the same as described and illustrated in Fig. 40, except that they are operated by motors. A ½ horse-power Lundell motor is connected by worm gearing to the screw on which the contact brush travels. The po-

sition of these brushes is shown on the main switchboard by means of mechanical indicators operated by light shafting and bevel gearing connected to the switch screws. These indicators are shown in detail in Fig. 69. The cell regulating switches are so arranged that the two motors on each pair can be coupled together and the two switches operated as one; this is done when the battery is discharged at the maximum rate which is equal to the combined capacity of the pair of switches.

The battery switchboard is shown in Fig. 67. It consists of three enamelled slate panels mounted on an angle iron frame. On these panels are mounted the following apparatus in dupli-

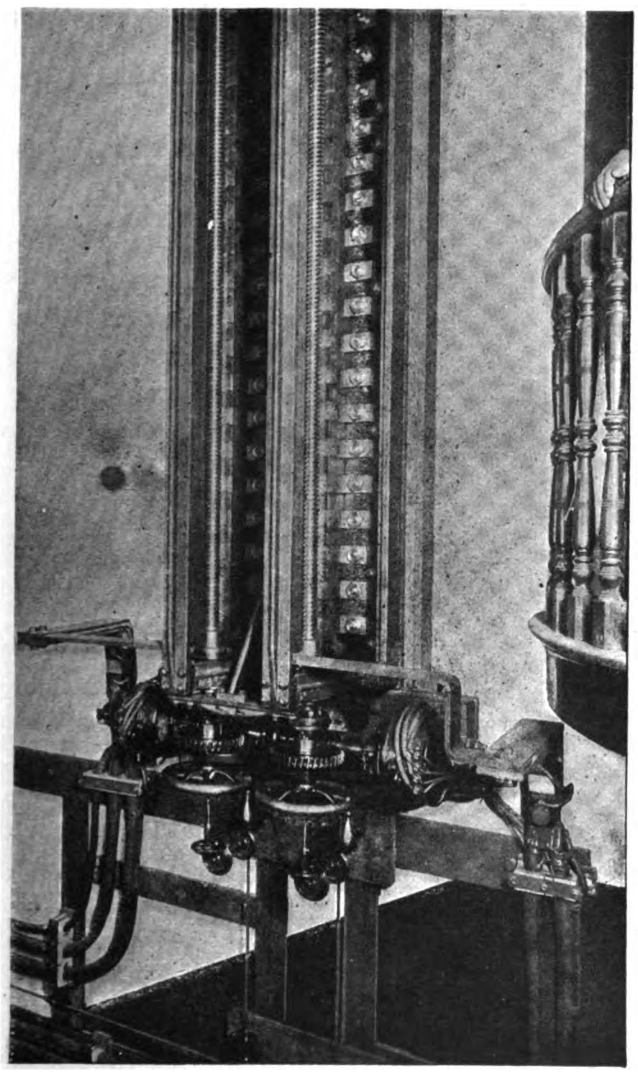


FIG. 66.—END CELL SWITCH, PHILADELPHIA EDISON STATION.

cate, one set for each side of the three-wire system: two motor control switches; two cell regulating switch indicators; two ammeters for cell regulating switches; one ammeter for battery neutral; one voltmeter with five point switch to read pressure on the two busses, the two-cell regulating switches and the charging buss; one low-reading voltmeter with 30-point switch to read the voltage of the end cells; seven knife switches to effect the various combinations described hereafter.

The switchboard is so arranged that either cell-regulating switch of each pair can be connected to the main, auxiliary and charging buss; also for the booster to be connected between the main and auxiliary busses. This combination enables the battery to be charged and discharged simultaneously; also to discharge at two pressures at the same time; also both cell-regulating switches to be connected to the same buss for maximum discharge.

The motor control switches are shown in detail in Fig. 68. They consist of five pairs of contacts arranged on the arc of a circle with a movable lever which makes the various combinations required to control the motor. The central contact is in the "off" position when the motor is entirely disconnected.

When it is desired to run the motor in the direction to cut in more cells, and raise the voltage, the lever is moved to the extreme position on the upper side. When the indicator shows that the traveling brush on the cell-regulating switch is nearing the proper position on the contact, the lever is moved down towards the "stop" position. During this movement it short circuits the armature of the motor, which is series wound, first through a resistance and then on dead short circuit, at the same time inserting in the motor circuit a resistance to keep the current normal when the armature is short circuited. When the operation of the motor is completed, the lever is moved to the "off" position. The same operation is required for cutting out cells, except that the lever is moved to the lower side of the arc.

Fig. 69 shows in detail the indicating apparatus. It consists of a dial and pointer operated by gearing from the screws of the cell regulating switches. The dial is divided into thirty divisions, and numbered accordingly, one for each of the contacts on the regulating switches. The dial moves from one division to another as the brush on the switch travels from one contact to the next; at the same time the pointer

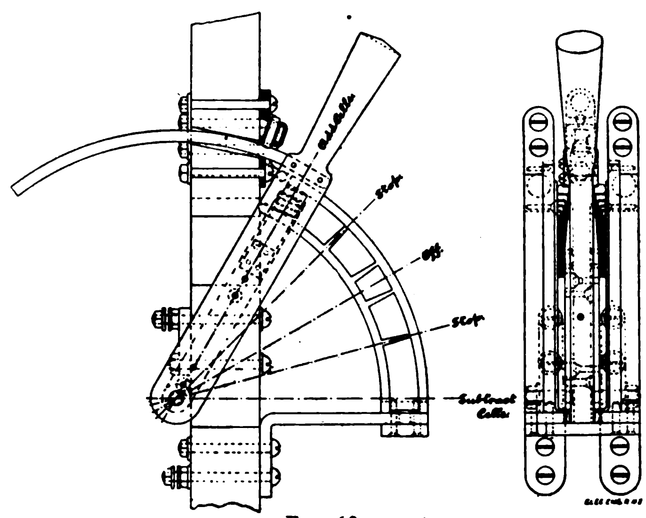


FIG. 68.

makes one complete revolution for every division on the dial. The exact position of the brush on the contact is shown by the pointer; in fact if the motor is stopped when the pointer is within two inches on either side of the zero mark, the brush is practically in the central position on the contact. This arrangement enables the cell regulating switches to be operated from a distance, and for switches of this capacity is more satisfactory than hand operation.

The low-reading voltmeter can be connected by means of the thirty-point voltmeter switches to any one of the end or regulating cells of the battery. These cells are worked unevenly, being cut in or out as required to maintain a constant voltage under varying loads, and, consequently, do not require the same amount of charge as the cells on the main battery. By means of these voltmeters and switches the condition of these cells can be ascertained at all times by the switchboard attendant, who can tell when they are fully charged and cut them out at that time. This method enables the battery to be worked at the highest point of efficiency with the least amount of attention, all the readings being obtained at the switchboard.

The ammeters are arranged as shown in the diagram of connections, viz., one on the battery neutral and one on each of the cell-regulating circuits, for the purpose of simplifying the work of keeping the records. The ammeter in the battery neutral shows at a glance what the battery is doing, while, in order to ascertain this from the ammeters on the cell regulating circuits, it would be necessary to add or subtract the two readings. For example, the battery may be charging through one switch and discharging through the other, or discharging through each at two different pressures. In both cases the net charge or discharge is shown by the meter on the neutral which is common to both circuits.

The charging of the battery is effected by means of boosters driven by compound wound motors, so wound that they will

maintain a constant speed under the varying voltage of the busses. These machines are of the same type as those illustrated in Fig. 42. All four machines are connected together by couplings so that one motor may be used to run both boosters when the charging current is light. The capacity of the booster is 1,250 amperes at 60 volts.

As a general rule this battery is operated in the following way: It carries the entire load of the station from 12.30 A. M.

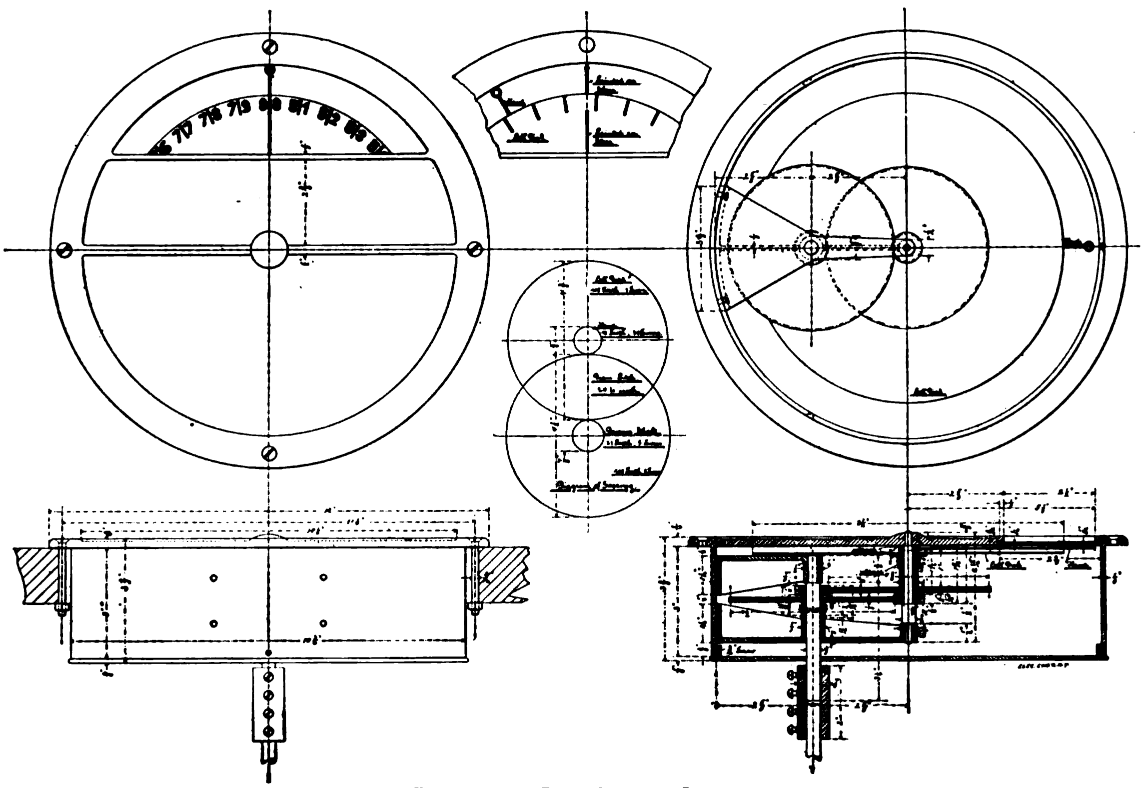


FIG. 69.—DETAILS OF CELL SWITCH INDICATOR

till 6.30 A. M., about 8,000 ampere-hours being the average capacity taken out during this time. From 6.30 A. M. on, the battery is charged, at the same time being used for equalizing the load on the generators. Between 12 M. and 1 o'clock P. M. when part of the motor load is taken off for the dinner hour, causing a drop in the load curve, the battery is charged at the maximum capacity of the boosters, bridging over this dip. By 4.30 P. M., when the peak commences to come on, the battery is full and ready to take its share of the increased load. Usually during the peak, which lasts about 1½ hours, the battery is discharged at the one-hour rate and saves this

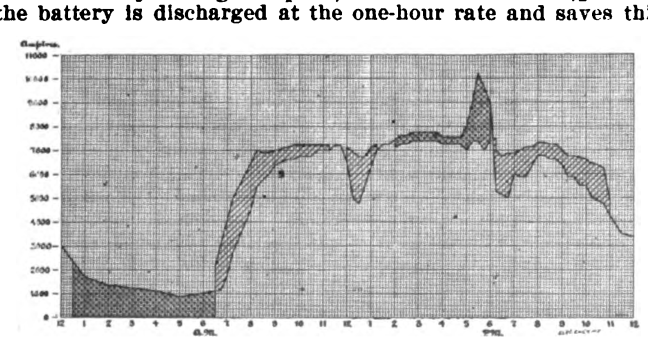


FIG. 70.

capacity in boilers, engines and dynamos being got ready and put in service for such a short time. After 6 o'clock, when the peak is over, the battery is charged again so as to be ready for shutting down all the generators at 12.30 A. M.

Figs. 61, 70, 71 and 72 show typical load curves of this station and explain the methods of operating the battery under different conditions which have been found most economical. Fig. 61 is the load curve of a maximum winter's day just before Christmas. The load reached 20,500 amperes during the peak, and the battery took 7,400 amperes of this, instead of having to get ready this capacity in generating machinery for two or three hours' use only.

Fig. 70 shows a summer's day load when the peak is very small. In this case the battery carried the entire load of the station for 6 hours, from 12.30 to 6.30 A. M. and within one hour from the time of starting up the generating plant the load reached its normal and by means of the battery the load on the generators was maintained practically constant for 14 hours, from 8 A. M. till 10 P. M.; from 10 P. M. till 12.30 A. M., when the battery would again carry the entire load, the generators were shut down as the load fell off. This load curve shows the beneficial results of a storage battery as applied to a central station and will prove intensely interesting to all engineers who are endeavoring to straighten out their load curves. These results were obtained on June 15, 1897.

Fig. 71 illustrates a Sunday load curve when the entire load of the station was carried from 12.30 A. M. till 2 P. M. by the battery, the capacity taken out of the battery being about 14,000 ampere-hours. When the generating plant was started

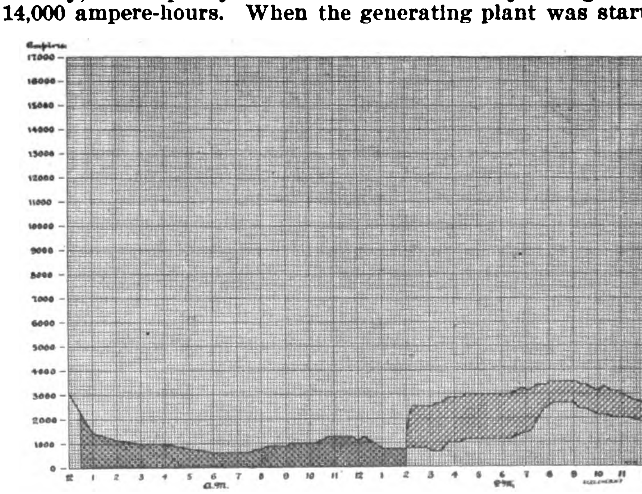


FIG. 71.

up, the battery was charged and helped to keep a constant load on the generators. In addition to this, the fact of having thirteen consecutive hours for repairs and overhauling with all machinery shut down in the station is a great advantage to the central station operation.

Fig. 72 shows the load carried by the station on a day in May, 1897, when a thunder storm occurred during the after-

noon. On this occasion the load increased in a few minutes to the amount of 6,000 amperes beyond the capacity of the generators in operation, the whole of which was carried by the battery, the pressure being kept up to normal during the entire time the increased load continued. Without a battery it would have been impossible to maintain the regular service without a drop in the voltage and candle-power. The value of a battery under these conditions cannot be overestimated.

It is impossible to get sufficient generating machinery into operation on such short notice and very uneconomical to keep such capacity in readiness for cases of emergency.

A storage battery enables the station to be run practically without any generating machinery being kept in reserve for emergency and is capable of tiding over any period of sudden

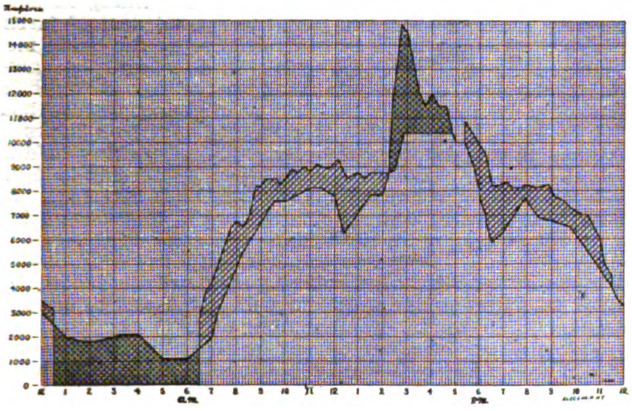


FIG. 72.

increase in load or trouble in the station till the additional machinery can be started up.

With the exception of a few weeks at Christmas time, when the load is abnormal, the battery enables, practically, a constant generator load to be maintained from between 8 and 9 o'clock in the morning, till 9 o'clock at night, between which hours no change in the capacity of the generating plant is necessary, the units running being fully loaded all the time. It is only between the hours of 6.30 and 9 in the morning, and 6 and 12.30 at night that additions or reductions have to be made in the number of units required in operation.

It is found in actual practice that the battery is equal to 2,000 horse-power capacity in boilers, engines and dynamos, this capacity being available at a moment's notice, which is not the case with the generating plant. The results obtained in this station are good, but not more favorable than can be met with in many other situations, and it only requires the managers and engineers of central stations to look more fully into the advantages occurring from a properly designed and installed battery plant before they will be considered indispensable.

ELECTRICAL MACHINE SHOP PRACTICE.—III.

BY JAMES F. HOBART, M. E.

THE babbitting of motor boxes, particularly for street railway work, is a matter the mechanical engineer has had quite a number of tussles with, and has not come off best every time, by any means. In the shop where the bearings are first lined with soft metal, and are free from old babbitt, dirt and grease, and only a few boxes have to be lined—or rather only a few kinds,—it is different from what it is in the repair shop with cars from about every shop in the country—at least so it seems. Then, there must be jigs for every kind, and the "know how" to use the jigs after they have been made.

Split boxes are comparatively easy to rebabbitt, and nothing will be said about them in this connection. But to turn out a good solid box, with perhaps an end flange or collar of soft metal, is another matter altogether.

A number of years since, the Thomson-Houston Company made drawings of elaborate collapsing mandrels for this kind of work, and after finding that it would cost several thousand dollars to equip their works with the variety of mandrels needed, I believe the project was dropped, and solid mandrels were used for box lining.

One of the best babbitting mandrels, as well as the simplest I have seen, is shown in Fig. 10, the mandrel, A, being a piece of plain shafting turned down at the ends, a and b, to fit the bearings, a, a, Fig. 11. In Fig. 10 B shows the mandrel with a pair of heads in place, head c being plain, while head d is cupped as shown to form the end collar or bearing shown at a, a, Fig. 12. In this engraving, b b, shows a section of the iron box, and c c is the usual lining to which the end collar is an addition.

In this section, and in succeeding sketches, the box is represented by a plain cylinder and all outside detail is left off, for clearness. In Fig. 13 a box is shown on the mandrel, with heads in place, all ready for pouring. When the end ring must be cast on, the head, b, must be the same diameter as the box, but when the ends are to be plain, the heads may be of any diameter, as seen at d.

When the heads are in place, a strip of tough binder's board, e, is wound around the junction between box and head, at the end where the collar is to be cast, and by means of this strip

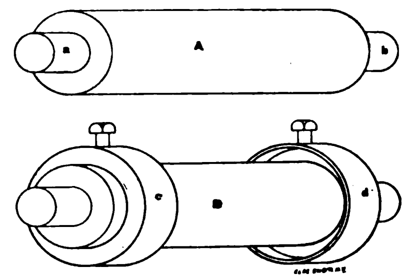


FIG. 10.—MANDREL FOR LINING SOLID BOXES.

any thickness of collar may be cast. A couple of strings, f, f, are tied around over the binder's board to hold it in place. In some shops, a neat spiral spring is made endless, and slipped on to hold the board. Other shops use flat springs of very thin steel bent up like trousers' guards that the bicycler uses. In fact, I have seen these very guards doing duty at the babbitt bench.

In pouring the box, the molten metal runs in through one of the holes, i, i, which are provided expressly for that purposes, and are left filled with babbitt when the job is done. The small ends, g, h, are to fit the bearings in the jig, as stated, and prevent both side and end motion of the mandrel, as the ends, one of which is seen at a fit snug between the bearings, a a, Fig. 11.

The "anvil," b, in this illustration, is bolted to the bearing piece, a a, and may be made interchangeable for different sizes of boxes, but experience has shown that better and truer boxes can be turned out when separate jigs are used for different sizes; there is less chance for the mandrel and box to get out of line when clamped in the jig, and as the hole must be parallel with the casting, in any finished box, it is necessary to allow every point that is in favor of this result.

Both the bearings, and the saddle, a, e, and b, Fig. 11, should be bored at the same operation, so as to be in line; and the anvil should be so locked and bolted to the bearing strap,

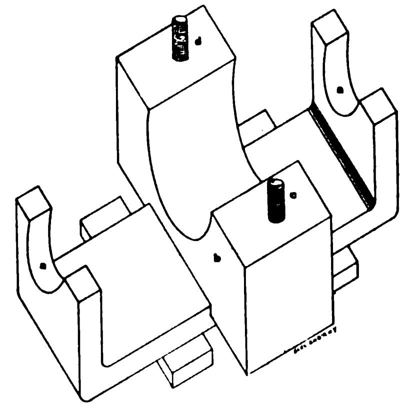


FIG. 11.—JIG FOR LINING SOLID BOXES.

that there will never be any movement between them. The accuracy of the finished box depends upon the correctness of the jigs, and they can profitably have considerable time spent on their making and care after being made and in use.

A common planer clamp, made of three-quarter inch square steel, is placed on top of the box after it is in position in the jig, and is held by screwing down the nuts on studs, c, d, making everything solid and ready for the babbitt. The pouring should be done quickly, a stream as big as will go through the hole, being run in. The mandrel and box must be warm, in order to secure a good bearing, and the metal just hot enough to flow well. The thinner the cavity or space into

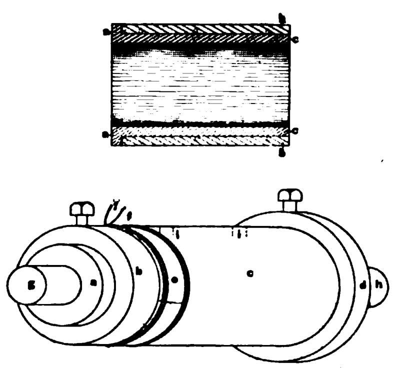
which the babbitt must run, the hotter it must be, and the greater the necessity for having the box well heated also.

More attention should be given to melting babbitt metal than is now paid that important part of the work. Often all the appliances consist of a cast iron kettle, or a pot, requisitioned from some restaurant or scrap heap, is the crucible in which the lining metal must be melted. This will do, but it is far from the best, or the most economical appliance.

Get a crucible made for the purpose, one that is large and deep, and into which there can be put a dozen boxes for the purpose of melting out the old babbitt metal. Take a few lessons from the type founder, and instead of having to dip out the hot metal with a ladle, have a spout arranged much like the flow-trough of an iron-founder's furnace; then with a valve arranged to work from the outside, the hot metal can be drawn off as desired without getting a lot of dirt from the top of the metal, and without the necessity of keeping the hot metal uncovered so it can oxidize itself into dross at a fast rate.

The pouring, as stated, should be done with a full stream, and as soon as the metal is in, the nuts should be taken off and the box removed from the jig to a driving-off stand. The great trouble with the casting of solid boxes is to get the mandrel out. This must be done before the metal has a chance to cool much, for the longer the mandrel stays in contact with the hot metal, the harder it will come out. The best way, then, is to remove the box as soon as possible and set it on a "driving-off stand," which is exactly similar to the usual rig for driving out mandrels. The usual copper or rawhide hammer is used, and the mandrel forced out.

A good deal of care should be given to melting out the old lining without heating the babbitt kettle too hot. There is a



FIGS. 12 AND 13.

fine opportunity for burning out the bottom of a kettle of this kind, and much care is necessary to prevent it. The melting out heat should never be greater than is barely necessary to start the babbitt, and if the iron is just hot enough to flash oil into flame, then the babbitt will come out and no harm be done to the castings. Indeed, I believe that a cast iron box is all the better for having been heated in this manner for several times, as the strains of casting are allowed to readjust themselves; it gives the castings a sort of annealing, and makes them tougher and less apt to fail under the strain of operation.

The usual method of cleaning a box after the old lining has been melted out, is to rub off some of the dirt with the stub of an old broom. There is a much better way than this: get a few scratch brushes and rub one of them over the box. It will take off all the dirt, slick and clean, and there will be no burning of the broom, and making a big smoke and stench. A small scratch brush that will go into the box, should be used for cleaning out the inside of the casting. A better lining is always the result when both box and mandrel are very clean.

Grease and oil will do no harm in a box when the babbitt is poured in, but beware of any water. The presence of moisture will always cause a poor surface to the metal in the lining, even if it does not spoil it, and there is always great danger of an explosion which will throw the hot metal many feet, when moisture comes in contact with melted lead or any other metal.

When the open pot must be used for both melting out and for filling boxes, nearly all of the waste of metal by oxidization and the trouble from dirt may be avoided by putting a ring into the metal to dip the ladle through. Just a piece of large stove pipe is all that is needed. When ready to pour a box, fan the dirt away with the pipe and push it right down into the hot metal.

The piece of iron need not be very long, four or five inches is enough, and after working it down through the dirt and dross, let it go and it will float in the hot babbitt, probably not quite one-fourth of the iron projecting above the babbitt. This is under the supposition that the iron has a specific gravity of about 7.7, and the babbitt metal averages 10. This would give about 77-100 of the iron under the babbitt, and 23-100, or a little less than one-quarter, as stated, to stick up above the top of the metal to keep the dirt away so the ladle can be dipped directly into the clean babbitt without having to stop to skim or to run the risk of pouring a bad box without skimming. Take the iron ring out when not pouring. A lot of the babbitt will oxidize in a short time when the clean bright surface of the hot metal is exposed directly to the atmosphere.

When trouble is met with in keeping the lining in boxes, especially when they are subjected to a good deal of jarring, the inside of the casting may be tinned before the lining metal is poured in, and, if the tinning is well done, and the babbitt metal pretty hot, it will join itself to the box so tight that it can only be got off by melting or chipping. Brass boxes in particular take kindly to this method, but iron boxes can be tinned by means of acid baths, by first picking in dilute sulphuric acid to remove the scale, then immersing in hydrochloric (muriatic) acid in which zinc has been dissolved. This gives the iron a thin coating of zinc, and if poured very hot—hot enough to melt lead, the babbitt will stick to the thin zinc coating.

It is better practice to go over the inside of the boxes, after dipping in the acid-zinc solution, with some melted lead and tin solder), and work a coating of it on over the zinc. This is easily done by keeping the box hot over a gas flame, or a charcoal fire, and working the melted solder around with a small scratch brush which is occasionally wet in the acid-zinc solution. As soon as tinned, the boxes should be put on the mandrel, in the jig, and poured while hot. There is no get-away to a lining put in thus. It is expensive, but pays for certain places.

TELEPHONY AND TELEGRAPHY

GLASS TELEPHONE CABINETS.

BESIDES the requirements of imperviousness to sound which telephone cabinets call for, there are others which a perfect structure of this kind requires. Among other things the matter of interior illumination is of importance, and frequently the absence of light is the cause of considerable inconvenience. The illumination must be such that reading and writing are easy. Even when good daylight is available large windows do not often permit of this, and it also happens even with artificial light, when placed outside of the booth to avoid excessive heat. It is also desirable in using these

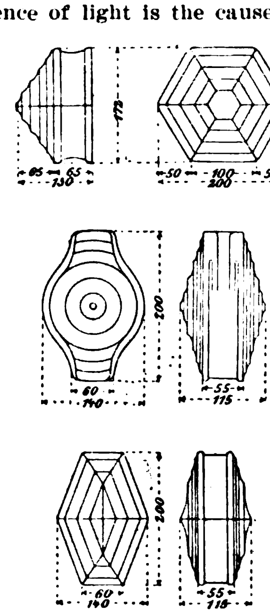
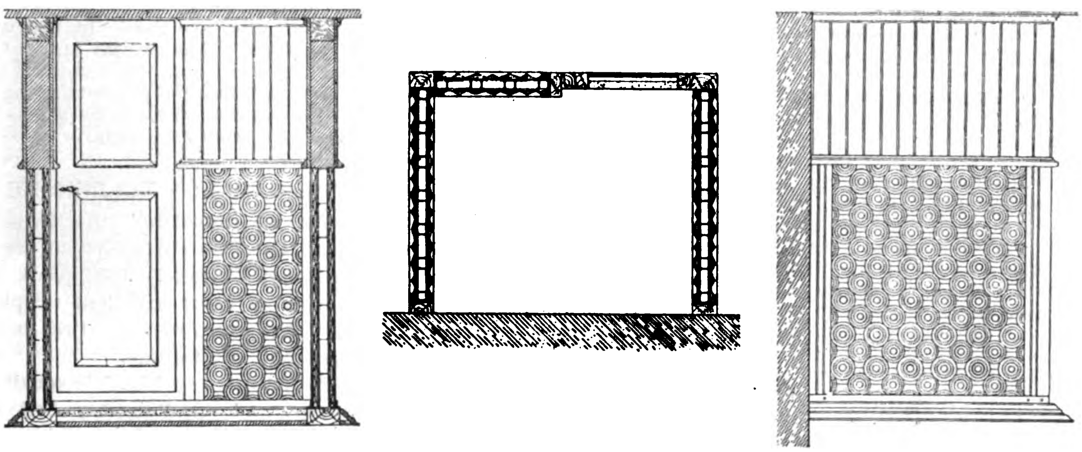


FIG. 1.

booths that the presence of a user telephoning should be noticeable from without the cabinet, yet that the features of the person within cannot be recognized, and especially that the memoranda made by the user of the telephone cannot be read from without. These conditions are but rarely satisfied with milk or ribbed glass. Large panes of glass seriously interfere with the sound-proof qualities of the booth, and have the disadvantage that in case of damage the repairs are quite expensive.

Most of the difficulties above enumerated, says the "Elektrotechnische Zeitschrift," are overcome by the Falconnier glass "building stones." These glass stones are hollow bodies, the interior of which is filled with compressed air. They are employed in hexagonal or fish bladder shapes, as shown in Fig. 1, and come from the glass works ready for use, and their application is quite simple. They are laid like ordinary bricks in mortar, consisting of 1-5 fine sand, 3-5 Portland and 1-5 Roman cement. The joints must be completely full, and can be pointed immediately after laying. Where the light is to be brought in from above, arches built up of these glass stones can be constructed in the same manner as is usually done in the case of bricks. Figs. 2, 3 and 4 show side elevation, vertical and horizontal section of the telephone booth, three sides of which are constructed of these glass stones. The latter rest upon a breast wall of bricks covered by an apron of boards. A frame of U and T-irons forms a skeleton for the glass walls and for the fastening of the wood framing of the door, etc., and also as a support for the roof.



FIGS. 2, 3 AND 4.—METHOD OF CONSTRUCTING GLASS SOUNDPROOF TELEPHONE CABINETS.

In locations where the temperature is low, and the variation in humidity not great, the frame could also be constructed of wood. The roof and the door are built up of wood and cork, with a layer of air between them. There is no difficulty, however, in constructing even the door of glass where the requirements of absolute sound-proofness demand it.

The cabinet illustrated has been in use for 1½ years, with good results, and the imperviousness to sound attained with it is said not to be attained with any other building material.

PRIVATE TELEPHONE CONSTRUCTION.—II.

BY F. H. SMITH.

IT is quite a common thing for a merchant in a town to have his home and store connected with his place of business by telephone. Such is true of the doctor between his home and office, also the lawyer, and some other business men and professional people.

In the smaller towns this is quite an easy matter, since the right of way for wires can be secured, but in the large towns and the cities this does not hold true. It is quite a common thing in the cities for persons to buy telephones and arrange with some linemen to put them up and string the necessary wire; but soon endless trouble with the circuits commences. The wires are found on buildings and are disconnected, also on the poles of the various electric companies, when they are cut down. Before buying instruments for a private line in a city it is a good plan to try and make arrangements for the circuit. Sometimes arrangements can be made with some one of the electric companies to have the wires strung on their poles and often arrangements can be made with the property owners to have the wires fastened to buildings, if they are to be put up in a proper manner.

When two or three places are to be connected with telephones where the wire can be strung permanently, as many complete telephones should be purchased with magneto bells for calling purposes. Two good open circuit batteries for each instrument, a sufficient quantity of No. 14 B. and S. iron or steel wire, the best grade, and the best lineman that can be procured should be employed to put up the wires. If poles have got to be set, get them heavy enough, so that when well tamped for four or five feet in the ground, they will stand straight. Find out from the local electric companies what timber makes the best pole, in the section where the work is to be done, cost and lasting qualities considered; have them at least four inches in diameter at the top and long enough so that the bracket, if one wire is to be strung, or the cross arm if two wires, shall be 18 feet above ground.

If the wire is what it should be and is not damaged in putting up, it should hold together during a bad sleet storm if the poles are 200 feet apart. The regular two-pin arm and pony glass will complete the outside equipment.

In the country where there are no gas and water pipes, especially if the soil gets very dry during some seasons of the year, two wires should be strung so as to have a metallic circuit. If a river runs parallel with the pole line, it may be used for a return by running a wire from one side of the

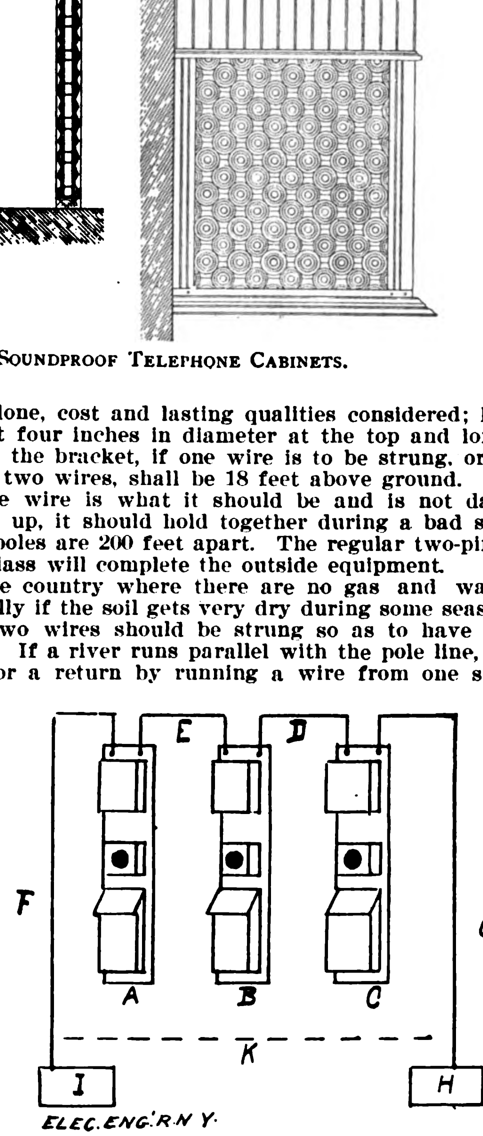


FIG. 1.

telephone to a small iron or copper plate on the bank and putting the plate where it will always be under water. In using plates in the ground they should be put deep down in wet or swampy places. Very much trouble has been had with private telephone lines when the ground has been used for a return.

Fig. 1 illustrates the arrangement of the instruments in this case. All three bells will always ring at once, and if the three ear pieces are down, a person speaking in any one transmitter can be heard in the other two. The principal objection is the system of ringing that is necessary. With only two telephones one ring is all that is necessary to call for either telephone, but with three it is essential to have an understanding that one ring calls a certain instrument, two rings another, and three rings the third phone.

We will consider A, B and C to be the three telephones connected by the line wire E and D; F and G the wires that are the ones leading to the water pipes, or ground plates H and I,

or back to the wire K, when no ground return is used.

Fig. 2 illustrates the warehouse system with no central station. We will consider that we are going to install five stations. • We will adopt the full length case with battery box large enough for two wet batteries in case we should want to use two, as the instruments are going to be some distance apart, and we want to use small copper in the circuits, and get a good sharp ring at calls; we will decide on telephones with magneto bells for calls. Young and old, short and tall are to use the instruments, so we are compelled to have adjustable arms.

The factory in which they are to be installed, we will suppose, has rapidly running machinery that will tend to shake the instruments, so we will try to get them all on the brick walls that enclose the place.

Some warehouse telephones are made with a small switchboard in them, which is operated with a plug; this plug has got to be placed by hand and makes a very good arrangement, when every person is well instructed in the use of the apparatus and will leave the plug in the proper place when through using the telephone, so that the station can be called when wanted. Employés can, to a greater or less extent be controlled, but in our case we will consider that persons from the outside are going to be around the factory at times and use the telephones, and we want the best service we can get, if it don't cost any more. We will adopt the round switch with five points and have a spring in the lever of the switch

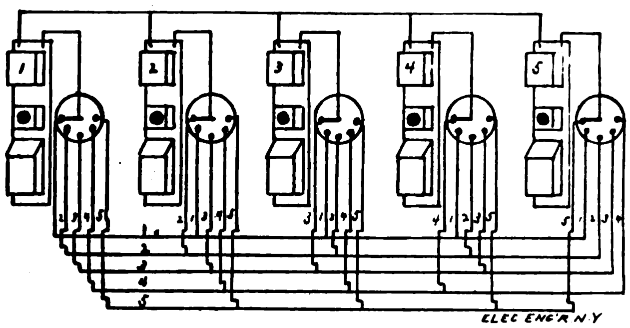


FIG. 2.

so that when the hand is taken from it the switch will return to the proper point for a call. It is very trying to undertake to get a remote place in the system and fail, simply because some person in a hurry has left the switch on the wrong point.

There is one disadvantage with having the switch so arranged that it is necessary to hold the hand upon it while speaking to a person at another station, and that is the fact that the switch has got to be put in some convenient position for the hand to be placed when the telephone is being spoken into. If placed right over the battery box, when made into the telephone case, it is all right for either a right or left handed person. When not built into the case it might be put right under the battery box on the wall, but in such a place it would be difficult to see.

The next best place would be just to the right of the top of the battery box. One of the first things that a person, who has a telephone that is not automatic in replacing the switch, will say is: "You cannot write while using the telephone if both hands have got to be used to operate the apparatus." This is true, and should be considered in deciding this question. It is quite an easy matter to take part of a message, write it down, and then take more and so on. This would be the writer's choice rather than have the apparatus so that it could not be used most of the time.

In our case we will not wed ourselves to any particular make of telephones, and so we will put our switch just to the right of the apparatus, as in Fig. 2. For five telephone stations we will use annunciator wire No. 18, B. and S. gauge with five colors or combinations of colors in the insulation. White and blue for the wire running directly to each instrument independent of the switch. Thus we will never be compelled to do any tracing but will know just the wire to use for the binding posts that are all connected to one straight wire. In this case they are on the left of the instrument. The right hand posts could just as well be used, but if one right hand post is used for this purpose, for the same purpose the right hand post of each instrument should be used to make the work symmetrical.

For No. 1 station switch wire we will use white and blue; for No. 2 white and red; for No. 3 red and blue; for No. 4 plain blue; for No. 5 plain red. On paper this looks very simple, but let a careless fellow, with but a faint idea of the task on hand, undertake this work with one or two colors of wire, and some great running, guessing, testing, changing and swearing are apt to be done before the job is complete, and the wire at places will be a hopeless snarl. A good man at the business could use one color of insulation and a few tags, where the work was concealed, and come out all right, but the average all-around wireman could not do it.

In some cases the battery in combination with a push, is used to work the call bells, but it is a question if this is economy in the end. Good magneto call bells are not expensive, and it is policy to always dispense with battery current, if possible, in such work.

If connections and taps are made in the wires, all such should be very carefully soldered and taped. In the engraving it looks as though it would be necessary to make many taps or many times add branch wires running to the various switches, but if the work is planned by a good man, in many cases the tap will be dispensed with.

THE STROMBERG-CARLSON TELEPHONE APPARATUS.

In a recent issue we illustrated the telephone exchange switchboard of the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. This week we are enabled to describe a variety of other excellent telephone apparatus, manufactured by that company, relating more particularly to the subscriber's end of the line.

The transmitter illustrated in Fig. 1 is sensitive in its action yet not too delicate, and requires very little battery power. The diaphragm is not loaded or damped in any way, and its full vibration value is realized, while the double diaphragm renders the transmitter moisture-proof, and prevents buckling

FIG. 5.—STROMBERG-CARLSON CABINET SWITCHBOARD.

of the vibrating diaphragm by the heat and moisture of the breath. With this transmitter, and the Stromberg-Carlson receiver, conversations have been carried on with one of the parties standing at distance of 100 feet from the telephone. For mines and other damp places it is hermetically sealed, and made so watertight that it can be totally immersed in water without the entrance of moisture to pack or sicken the carbon grains.

The Stromberg-Carlson receiver is a specially loud speaking apparatus. This receiver can neither be tampered with nor thrown out of adjustment by variations of temperature. The special bi-polar magnets are capable of sustaining a dead weight of six and one-half pounds. All expansion of the magnets is away from the diaphragm end, the poles being firmly fixed to a solid brass head, so made that the distance from poles to diaphragm, when the receiver is once adjusted and locked, remains always the same.

There are no binding-posts for attaching the cord, and therefore no breakage or loose connections are possible. The

receiver is hermetically sealed, and excludes all moisture, dust, and other foreign substances.

Fig. 2 illustrates the type of long distance and wall exchange transmitter set. Between the usual magneto and battery boxes is placed a "triplet set," which is a self-contained arrangement of transmitter, receiver, switch and induction coil, compactly assembled. The extension arm is of the usual pattern, permitting adjustment to the heights of different individuals. Only two cells of battery are required up to any distance not exceeding 2,000 miles.

Fig. 1.

Fig. 4.

Fig. 2.

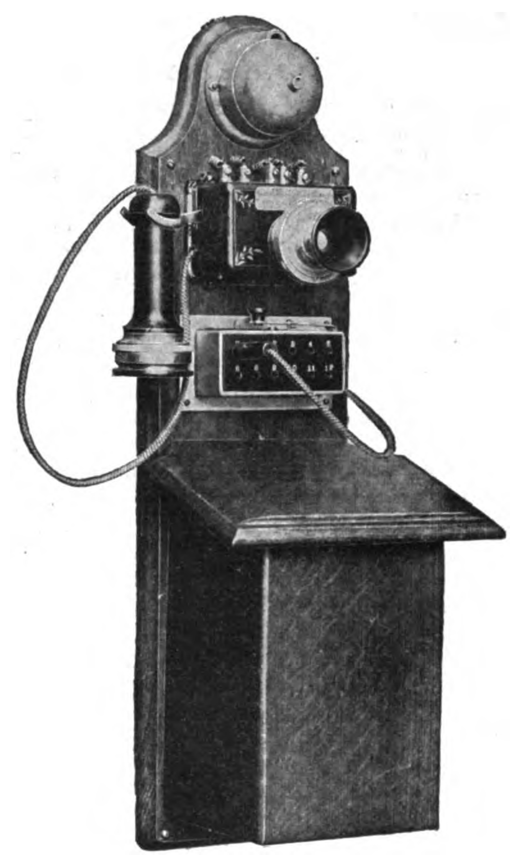


Fig. 3.

Stromberg-Carlson Telephone Apparatus.

To meet the demands of an intercommunicating system in houses, factories, offices, etc., the company have designed a complete local system, the transmitter of which is shown in Fig. 3. The local plug or switch is placed below the transmitter "triplet." An original and valuable feature of the system is, that it makes no difference whether the local plug be left in its proper jack or not; the station can always be called from any other station. The system is also arranged so that eavesdropping can be rendered impossible. Fig. 4 illustrates the desk set designed for the intercommunicating system.

Where the number of instruments is such that the plug board can not well be attached to the transmitter, the company build the cabinet switchboard shown in Fig. 5. These are made up in sets of less than 25 drops.

TO AVOID "BUSY" CALLS.

In order to expedite the use of the telephone on Saturday morning, and as much as possible avoid "busy" calls, the Chicago Telephone Company is advising its patrons to spread out the time of use on that morning so as to cover as many hours as possible, and for that purpose the following notice is being sent to the subscribers in the Chicago exchange:

Owing to the general observance of the Saturday half holiday and the consequent rush of business during the morning hours of that day subscribers will expedite their own calls and avoid "busy" calls to a greater extent by extending the period of use of their telephone over as large a number of hours as possible. A very great number of subscribers now attempt to do all of the morning's telephoning between the hours of 10 and 11. As a result, many unavailing calls are made for lines which are almost continuously busy during that hour. By beginning the morning's business which is accomplished by telephone at an earlier hour and extending it at a more even rate up to 12 o'clock, the service will be expedited. Subscribers whose telephones are of greatest value for receiving calls are recommended to keep their lines as free as possible for that purpose and to avoid blocking them by outgoing messages. Subscribers who have more than one trunk line or telephone are recommended to keep one line free for incoming work as much as possible.

STOCK TICKER QUOTATIONS IN NEW YORK.

The contract under which the Western Union Telegraph Company obtains the quotations which it distributes to the public over the tickers of its subsidiary company, the Gold and Stock Telegraph Company expired with the close of business on the Exchange June 30. It is not expected, however, that the quotation service will be cut off. The Committee of Arrangements of the Exchange has the power to continue to furnish the quotations from day to day to the Western Union Company without a new contract, and this is what Wall street generally expects will be done in case a new contract is not at once arranged. Any new contract is expected to be in terms that will prevent the quotations from going to the bucket shops.

It was announced at the office of the Western Union Telegraph Company that there would be no interruption of quotation service over the tickers because of the expiration of the contract. No details have ben given as to the terms or conditions under which the service will be continued.

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MILLIONS IN IT FOR MORGAN.

IF one of the Sunday newspapers is to be believed—and we all know how thoroughly trustworthy some of them are—the only time that Mr. J. P. Morgan ever let his friends into a hole was when he got them to put money into General Electric. But, according to the New York "World" of July 11, he is going to rectify even that little blunder, and show that it was not a blunder by pulling off the biggest thing ever known in the booming of Wall Street industrials. Mr. Morgan's plan of campaign is based on two elements, viz., the third-rail system and the control of nine systems of steam railroad. Everybody knows what a howling success the third-rail method is, and in applying that to 27,367 miles of track, Mr. Morgan and his associates will make $136,000,000, a sum which is estimated altogether too low, as only 25 per cent. profit is allowed, when it is a notorious fact that the profit on electrical apparatus is nearer 75 per cent. However, we will let the "World" do its own cautious figuring, and here reproduce its own table of careful calculations:

HOW MORGAN MAKES MILLIONS.

His 27,367 Miles of Railroad Will Be Equipped with the General Electric Company's "Third Rail" System Which He Controls.

WHERE THE GAIN COMES IN.

Name of Railroad.	Mileage.	Cost of Third Rail Equipment.	Morgan's Profit.
New York Central	5,280	$105,600,000	$26,400,000
N. Y., N. H. & Hartford	2,023	40,460,000	10,115,000
Erie	3,727	74,540,000	18,635,000
Philadelphia & Reading	1,277	25,540,000	6,385,000
Lehigh Valley	2,694	53,880,000	13,470,000
Southern Railway	4,752	95,040,000	23,760,000
Northern Pacific	4,346	86,920,000	21,730,000
Cleve., Cin., Chi. & St. L.	2,435	48,700,000	12,175,000
Chesapeake & Ohio	843	16,860,000	4,215,000
Total	27,367	$547,540,000	$136,885,000

HOW IT WILL AFFECT STOCKS.

Authorized capital, General Electric Company	$50,000,000
Stock issued, common, par value	30,460,000
Stock issued, preferred, par value	2,260,000
Controlled by J. P. Morgan and friends, par value	25,000,000
Present market value, Morgan holdings, at 33 1-3	8,250,000
Probable future market value, General Electric, per share	300
Probable future value of Morgan holdings	75,000,000
Net gain in value of Morgan stocks	66,250,000

SUMMARY.

Mr. Morgan's profit as a manufacturer of electrical railway equipment	$136,885,000
Mr. Morgan's profit as holder of electrical stocks	66,250,000
Total profit	$203,135,000

In view of the fact that General Electric is to earn $136,000,000 and to go up to $300 per share, is it any wonder that it is already up to 33½, or 8 points higher than at this time last year?

GERMAN CENTRAL STATION STATISTICS.

OF all the European countries, Germany may be said to have from the very start taken up electric lighting in the most enterprising manner. While the extent to which electrical work has been carried out in Germany has in the past been but a small percentage of the development which has been accomplished in the United States, yet as compared with its neighbors, the Fatherland has left them well in the rear. That Germany has not ceased its efforts towards popularizing the electric light is plainly shown in the most recent statistics of German central stations, which we find tabulated in excellent detail in the current number of the Elektrotechnische Zeitschrift. These statistics, aside from their being a mere record of good work accomplished, afford a fairly good insight into the tendencies of electrical work in Germany.

The record which is brought down to the first of March proves conclusively that electric lighting is no longer regarded as a luxury in Germany, but has become a necessity even in that country of highly developed domestic economy. While during the year 1894 only 148 central stations were in operation in Germany, there are now no less than 276, while 82 are in course of construction, or will shortly be begun. Taking a glance at the types of stations in relation to the nature of the current, power, etc., employed, we find that the direct current still leads, being employed in 70 per cent. of the stations, representing 66 per cent. of the actual total generating capacity. By far the larger number of direct current stations, that is, 80 per cent., are provided with storage batteries, the batteries representing 31 per cent. of the generator capacity of these stations. Nothing further is wanted to indicate the hold which storage batteries have gained in Germany. But it appears that the direct current is hard pressed by its old competitor, for we note a very decided increase in alternating current stations. Thus the number of exclusively alternating stations has risen from 16 in 1895, to 26 at the present time, and the generator capacity of these stations has increased correspondingly from 4,396 to 11,269 kilowatts. That is to say, an increase of 250 per cent. in eighteen months. On the other hand the total capacity of the exclusively direct current stations increased in the same time only 54 per cent. This is certainly a remarkable showing for the alternating current. During the same time the polyphase current has also taken a decided upward turn. We find no fewer than 27 such stations with a generating capacity of 11,163 kilowatts. In these 27 stations, however, there are included 11 stations having a capacity of 3,478 kilowatts, in which, in addition to the polyphase, direct current is also generated, or in which multiphase current is transformed into direct current for distribution. The accompanying table will enable a comparison to be made between the different systems in Germany during the last few years.

As regards the nature of the motive power employed, Germany is naturally restricted to a large extent to the employment of steam. Among the stations enumerated steam is employed exclusively in 57 per cent. of the total number, which represents 84 per cent. of the total engine capacity of all stations; and 17 per cent. of the stations are run by water power, but their total generator capacity amounts to only 4,300 kilowatts; whence it follows that only very small stations of less than 100 kilowatts depend exclusively upon water power. In fact, among these stations there are only 10 above 100 kilowatt capacity, and one of 1,360 kilowatt. However, there are 49 other stations which are also driven by water power, but have in addition another motive power, such as steam or gas as a reserve, but even in this case the total capacity only amounts to 5,463 kilowatts, so that, after all, only small stations are included in this category. It would seem, therefore, that the Germans consider it worth their while to utilize even the smallest water powers, even if forced to install auxiliary plants as a reserve in case of low water. Indeed, the statistics show that 36 per cent. of all the stations are at least partly driven by water power.

We have heard so much about the employment of gas lately in central stations that it is of special interest to note that gas cuts a very small figure in German central stations. In fact, we find only six stations with a total of only 460 kilowatt capacity, which are driven exclusively by means of gas; and in a few cases gas motors are used as reserve power. But what will strike American central station operators most forcibly is the fact that of all the stations in Germany one-half are of less than 100 kilowatt capacity. This indicates in a most marked degree that small towns which do not possess gas works are beginning to distribute light electrically. Among

the other stations 92 have a total capacity of from 101 to 500 k. w.; 13 from 500 to 1,000 k. w.; 12 from 1,001 to 2,000 k. w., and only 9 a total capacity of over 2,000 k. w. This is an exceedingly interesting development, and seems to indicate that in Germany the small station cuts quite as big a figure in the industry as does the large one.

As regards individual stations, the largest one in Germany, as it has been for some time past, is that of the Berliner Electricitätswerke in the Mauerstrasse, Berlin, with a capacity of 5,486 kilowatts. This is followed by the two stations in Hamburg, 4,760 and 4,182 k. w., respectively. Then comes Leipzig, with 2,300; Stuttgart, with 2,130 k. w.; Dresden, 2,088 k. w.; Frankfurt a. M., with 2,080 k. w., and finally two other Berlin stations of 2,028 k. w. capacity each.

	1894.	1895.	1896-97.	Per cent. Increase 1897 over 1895.
Direct Current.				
No. of stations....	120	139	204	47
Capacity in k. w...	30,468	35,166	54,273	54
Alternating Current.				
No. of stations....	15	16	26	62.5
Capacity in k. w...	4,208	4,396	11,269	156.3
Polyphase Current.				
No. of stations....	8	12	16	33.3
Capacity in k. w...	2,858	4,468	7,685	72
Polyphase and Direct Current.				
No. of stations....	2	4	11	1.75
Capacity in k. w...	646	1,746	4,366	150
Alternating and Direct Current.				
No. of stations....	3	2	3	50 .
Capacity in k. w...	175	115	607	427.9

The extraordinary increase in the capacity of the stations over the record of the preceding eighteen months indicates that the number of lamps and motors connected with the circuits is steadily on the increase, and also indicates that the fears sometimes expressed as to the effect of the Welsbach light on electric lighting are groundless. This is proved by a glance at the actual number of lamps connected, as illustrated in the accompanying table. Counting a 10-ampere arc lamp equal to 10 incandescent lamps, and 1 h. p. (German) in motors equal to 18 50-watt incandescent lamps, we arrive at a figure of 1,668,587 incandescent lamps, or 83,429 kilowatts, whereas the total capacity of all stations is 78,236 kilowatts. The above table will also show the enormous increase in the number of motors connected to the circuits during the last few years, which now amount to no less than 23½ per cent. of the total connected station capacity.

	No. of Stations.	50-Watt Inc. Lamps Connected.	10-Amp. Arc Lamps Connected.	Motors Connected H. P.
1894	148	493,081	12,357	5,635
1895	180	602,986	15,396	10,254
1896-97	265	1,025,785	25,024	21,809
Increase 1897 over 1895 in per cent..	47.2	70.1	62.5	112.7

All indications point to the fact that not only has Germany not reached the limit of its electrical development, but that, on the contrary, it has but fairly begun, and that a like increase may be looked forward to for several years to come. This is exceedingly encouraging from every point of view, especially keeping in sight the fact that the laws of Germany are very strict with regard to the formation and operation of private corporations operating under public franchises. These German statistics indicate that electric light can profitably be distributed under conditions which might be considered onerous in the United States. We venture to suggest that the excellent system of finance adopted, and, in fact, imposed, upon the stations in Germany has contributed much to this cheerful showing.

THE FUTURE ARC DYNAMO.

FOR a long time past one has heard so little of arc lighting machinery that one might almost be lulled into the belief that the art had become stationary. It is true that multiphase work has absorbed the best energies of electrical engineers during the last six or eight years, yet those who may have studied the situation a little closer will not fail to have noted distinct tendencies making themselves felt in arc lighting work. We do not here refer to the marvelous rise and progress in enclosed arc lighting which has led to the placing of over 30,000 enclosed arc lamps on circuits in the United States during the last three years; but we would rather call attention to the arc machine itself. The expensive operation of rows of thirty or forty lighters, which used to be the pride of arc stations of yore, was recognized in due time and led to the construction of larger units which have gradually assumed the proportions of 120 lighters and over, and we are given to understand that 300, and even 500 lighters, are on the tapis. But while concentration of power was recognized as a desirable end to strive for, it has also become apparent that this could be carried too far, and that some of the flexibility attainable with a larger number of smaller units was sacrificed. There are not many cities where circuits of 100 lamps or more can be operated to advantage, yet there are various situations in which 100 arc lamps are distributed on such classes of work that they are operated better on independent circuits. To enable arc machines of large capacity to fulfill this requisite has been the point kept in view in the latest constructions, one result of which is the most recent type of the Brush machine. A most interesting development in this new direction is the Rushmore machine, described on another page. In this machine the inventor claims to have solved the problem of leading out from a single machine a number of circuits entirely independent of one another, and hence individually regulable, an important advantage. While these developments are going on, one cannot help casting a glance toward the future of arc lighting. The enclosed arc lamp adapted for constant potential alternating circuits has given the arc light a firmer footing than it has ever enjoyed before. The continuous current arc machine will probably continue to hold its own for street lighting purposes for some time to come, but we note even now a tendency toward covering extended areas with alternating arc lamps, the ultimate outcome of which may make decided changes in arc lighting practice of the future.

DYNAMOS, MOTORS AND MACHINE SHOPS.

WITH regard to the views recently expressed at the Hartford meeting of the Mechanical Engineers, against the adoption of electric power in mills and factories, we find by inquiry that those ideas are far from being entertained by mechanical engineers in general. This was to be expected, for the members of the profession are highly intelligent, and have never yet failed to support any genuine advance in the arts. It may be pointed out as a proof of the real tendency in mechanics that while a large proportion of the work going through the engine, boiler, turbine and other machine shops is on electrical account, these shops are themselves not only liberal users of electricity, but are going into electrical work. More than one engine concern is building dynamos, not a few machine shops are turning out motors. But it is such steps as the recent consolidation of the Siemens-Halske Company and Pennsylvania Iron Works that are most significant of a process that has been going on for some years, and dates back at least to the time when Mr. Westinghouse began to give as much attention to electricity as he had theretofore paid to engines and air-brakes. The Walker Company, in Cleveland, is another large illustration of combining mechanical and electrical production, and it would not be stretching things to instance the growing Elwell-Parker Company as a case in which some of the best mechanical engineering talent in the country is deeply interested in manufacturing electrical apparatus on the grand scale. That more machinery shops of the first order will become largely, if not wholly, electrical in their output, we firmly believe.

ELECTRIC LIGHTING

THE RUSHMORE MULTICIRCUIT ARC MACHINE.

THE tendency of the past few years has been towards a steady increase in the capacity of arc light machines, so that whereas five or six years ago an 80-lighter was looked upon as a remarkable achievement, to-day 100 and 120-lighters are getting to be quite common, and machines of still greater capacity are promised. The tendency is also strong towards the designing of such large arc machines so that the output can be divided into independent circuits.

In line with this idea is a multicircuit arc dynamo recently constructed by Mr. S. W. Rushmore, of Jersey City, N. J., which is capable of supplying a number of independent circuits each automatically regulated from full load to short circuit, constituting as it were a true combination of a number of small machines with all the advantages that subdivision affords, but without its disadvantages.

The new machine is very simple in construction and has a large ring armature surrounded by a multipolar field. The field is somewhat different from the ordinary construction in that the magnet poles are not secured to a common field ring as in usual practice, but are arranged in pairs, each magnetically separated from the others. The armature and the poles are so proportioned that the section embraced by a

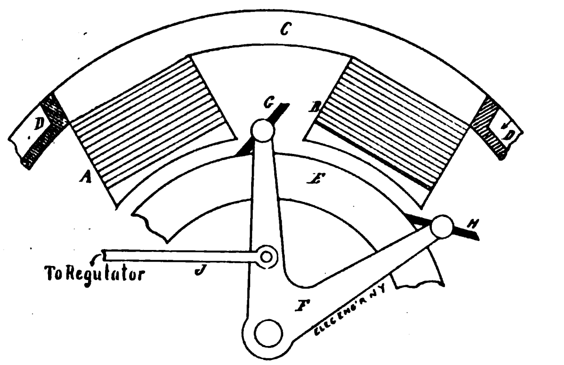


FIG. 1.

single pair of poles will have sufficient capacity to supply a circuit of arc lamps at the maximum voltage; and thus for each additional circuit the armature is made of greater size and there will be an additional magnet or pair of poles. In short, it is a number of arc machines incorporated in a single unit with an armature common to all.

In the first machine constructed on this plan some years ago, three brushes were employed for each section with one brush between the poles of each magnet and two brushes outside of the poles, the central brush forming one pole of the circuit and the outer brushes joined together to the other pole. This arrangement worked very well so long as the loads on the different sections remained the same, but when it was attempted to greatly vary the number of lights on one section, the brushes collecting currents for other circuits under other poles would flash badly and there was a great falling off in the capacity of the machine.

After studying the matter carefully, Mr. Rushmore concluded that this interference of the different sections was due to the current in the armature causing or allowing the flux from one section to flow to the other sections, and he concluded that the trouble would disappear if the armature flux due to the current in each circuit could be kept within its section, and he therefore arranged the machine with brushes to collect the current from the armature under but a single pole of each pair of magnets instead of under both poles. With this arrangement it was found that as much current could be collected from a section of the armature under a single pole as under both poles, while the idle pole served to keep the flux from flowing to the other sections; and no matter how much current was drawn from the armature under one section or separate magnet, there was no effect upon the other sections, and each section and pair of brushes would supply an independent circuit with varying current or pressure, entirely independent of all other sections.

In Fig. 1 is shown a section of the machine with a ring armature with poles A and B connected by yoke piece C; D, D are non-magnetic sections joining a magnet with other similar magnets to form a complete field; E is a section of the arma-

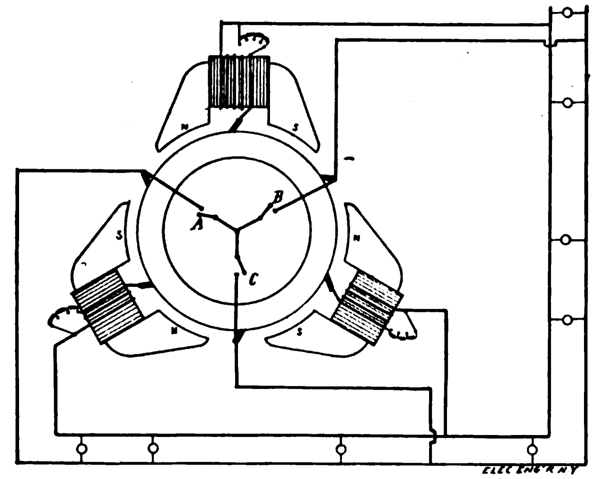


FIG. 2.

ture and F a brush rocker carrying brushes G and H, which are adapted to include between them the armature coils under pole B; J is a bar or lever connected to the regulator.

When the circuit supplied from the brushes is at its maximum voltage, the brushes will be shifted to a position with the pole, B, nearly central between them, and as lamps are cut out and less voltage is required, the regulator will shift the brushes toward pole A, thus distorting the field from pole B to keep down the voltage, as in bi-polar machines. As the current in the armature under pole A is only the small amount that will find its way around the armature from brush G to brush H, there will be little or no distortion of the field under pole A, and there will be no interference with the working of the other sections.

It has been found that machines constructed on this principle have very little tendency to flash and have such a wide inherent regulation that very little work is required of the regulator. The machine may be built with a large number of poles to supply a number of circuits and connected directly to the engine. In appearance it is practically the same as common types of multipolar machines, except that for each pair of poles there is a regulator to shift the brushes of that section.

This arrangement is not limited to arc machines, but may be applied to any service where it is desirable to have a single machine supply current at two or more different pressures, as applied to incandescent lighting and railway work. The machines may be built in large units to deliver the entire out-

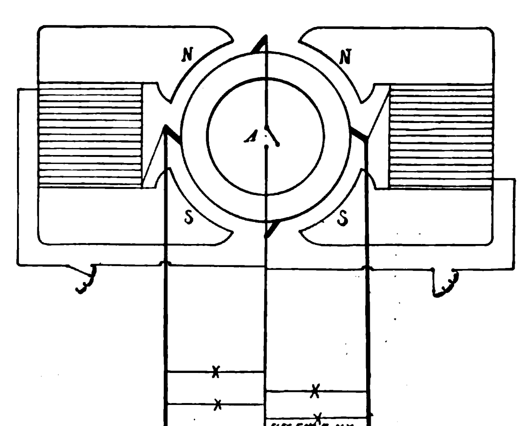


FIG. 3.

put at a single voltage, or at as many different voltages as there are pairs of poles surrounding the armature, as required. Thus, one or more sections of the machine may supply the main station buss, while other sections may supply feeders and be compounded to give any range of pressures required up to double the voltage of the main buss, thus dispensing

with boosters and special high pressure dynamos and improving the economy of the plant.

This is shown diagrammatically in Fig. 2, in which A, B and C are switches adapted to cross connect the brushes so that the current may be collected directly under a single pole of each section or under as many poles as conditions may require.

Fig. 3 shows the arrangement as applied to the three-wire system, in which case it is practically two independent machines connected in series and the load may be entirely removed from one side of the system without in any way affecting the other side, which may be fully loaded. In Fig. 3 A is a switch adapted to connect the brushes so that the current would be distributed equally throughout the armature, and this switch would be opened only when the system was so badly out of balance as to make it necessary to collect current under one pole as already described.

TEXT OF A PENNSYLVANIA BILL TO PROTECT LIGHTING PROPERTIES.

THE Simons bill, which compels municipal corporations in Pennsylvania to purchase the franchises and plants of existing electric light and gas companies before such municipalities can establish and operate plants of their own, is now in the hands of the Governor. It originated in the House and passed the Senate after being amended so as not to include water companies. The House concurred in the amendment, and the bill went to the Governor for his action.

The following is the full text of the act as it was sent to the Senate, which added a proviso exempting water companies from its operation:

An act supplementary to an act approved April 29, 1874, entitled "An act to provide for the incorporation and regulation of certain corporations," providing for the purchase of the franchises and property of certain corporations by the municipal corporation or corporations within the limits of which such franchises are exercised, and providing that such municipal corporation shall not itself undertake or perform any business or purposes of such corporation without first acquiring its franchises and property.

Section 1. Be it enacted, etc., that whenever rights, privileges or franchises have been or shall hereafter be granted by the Commonwealth to any corporation or corporations created under the act approved April 29, 1874, entitled "An act to provide for the incorporation and regulation of certain corporations," to which this is a supplement, or under any of the amendments or supplements to said act, and the exercise thereof by such corporations within the limits of any municipality or municipalities has been authorized or permitted by the municipal corporation or corporations by ordinances, contract, or otherwise, the municipal corporation or corporations within whose limits such rights, privileges, or franchises are exercised shall not itself undertake or perform any business or purpose of such corporations without first acquiring, in the manner hereafter prescribed, the rights, privileges and franchises granted to such corporation or corporations, and also the property of said corporations used in the exercise of said rights, privileges and franchises.

Section 2. That it shall be lawful at any time for any municipal corporation or corporations to become the owner of the works, property and franchises of any such corporation or corporations, by paying therefor such price as may be mutually agreed upon by and between such municipality and such corporation. If, in case of failure so to agree, such municipality or municipalities shall, notwithstanding such disagreement, provide by ordinance for the acquiring of the works, property and franchises of any such corporation, such municipality or municipalities shall thereupon present its petition to the Court of Common Pleas of the county in which such municipality or municipalities be located, asking for the appointment of viewers to assess the value of the works and property of such corporation in said municipality or municipalities, whereupon the court shall appoint seven discreet and disinterested freeholders of said county, and shall appoint a time for their meeting, of which meeting ten days' notice shall be given to all parties in interest; and the said viewers, having first been duly sworn or affirmed faithfully, justly and impartially to appraise said property and franchises, and having viewed the premises and taken such testimony as may be offered by either party touching the value of said property and franchise, shall estimate and determine the amount thereof, and make report of the same to the said court, which report having been confirmed by the said court, judgment shall be entered thereon by said court in favor of such corporation and against such municipality or municipalities. Each of said viewers shall be entitled to receive $2 for each day necessarily employed in the performance of the duties herein prescribed. Either party may, at any time within thirty days after the confirmation of such report, appeal therefrom to the said court. After such appeal, either party may put the cause at issue in the form directed by said court, and the same shall then be tried by said court and a jury, and, after final judgment, either party may have an appeal to the Supreme Court in the manner prescribed in other cases. The court shall have the power to order what notices shall be given in connection with any part of the proceedings, and may make all such orders connected with the same as may be deemed requisite. If any exceptions be filed with any appeal to the proceedings, they shall be speedily disposed of, and, if allowed, a new view shall be ordered, and, if disallowed, the appeal shall proceed as before provided; provided, that in estimating the value of all plants, franchises bestowed by municipalities shall not be considered a part of the plant.

Section 3. All laws or parts of laws inconsistent herewith are hereby repealed.

FIGHTING THE PROPOSED MUNICIPAL PLANT AT DES MOINES, IA.

A temporary injunction has been granted restraining the city of Des Moines from entering into a contract with the McCaskey-Holcomb Company for operating a lighting plant for the city, which should ultimately become the property of the city. It is claimed that the city may enter into debt to the extent only of $823,763, according to Iowa law, and that it now is and has been in debt to that amount, and hence that it has no power to incur further debt; that the bid was illegal because it was not founded on any bid made by the McCaskey-Holcomb Company in pursuance of a notice for bids; that the contract provides for public lighting for a period of two years, and that no such bid was asked for or received; that no appropriation was made for such a contract.

The election is said to be invalid and not to confer power to contract in this manner because no specimen ballots were prepared; no cards of instruction were prepared; the two propositions were contradictory and no citizen could vote for both at the same election; that 3,833 ballots were cast for both propositions and all such are illegal; that thirteen valid votes were cast in favor of the first proposition, and none for the second, and that 1,300 were cast against them.

ELECTRIC TRANSPORTATION

NIAGARA FALLS RAILWAY CONVENTION HALL.

AN illustration is shown herewith depicting the new convention hall at Niagara Falls, where the American Street Railway Association will meet next October. It was formerly the armory of the Forty-second Separate Company, and is situated on Walnut avenue, midway between the two busi-

EXHIBITION BUILDING, AMERICAN STREET RAILWAY ASSOCIATION, NIAGARA FALLS.

ness sections of the city. Its size when enlarged will be 132 feet by 132. The front is two stories high. On the upper floor is a hall for conventions seating from 200 to 300 people, and for larger gatherings the main auditorium is used. For

the purposes of the street railway meeting, all the space on the ground floor will be devoted to exhibits. The local street railway will run a branch to the hall for freight and passenger purposes; and a branch of the Erie road will also run to the building. The hotels are within ten minutes' distance.

THE FORD RAILWAY ELECTRIC TRAIN SIGNAL.

THE fact that a derailed pair of wheels, broken truck, broken car wheel, brake beam down, defective couplings, loads on flat cars shifting, and numerous other causes finally develop into expensive wrecks, which could easily be averted —provided the conductor could communicate instantly with the engineer, proves that a signalling device is required. The Ford railway electric train signal has been designed with this object in view.

It consists of a small three-wire cable properly insulated and

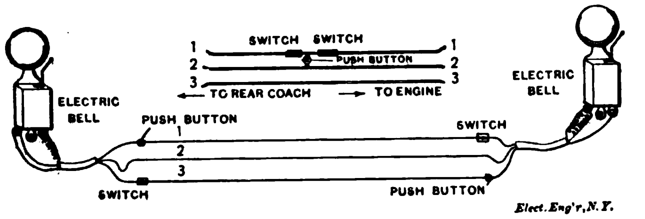


FIG. 1.—FORD'S RAILWAY ELECTRIC TRAIN SIGNAL.

attached to each car, both ends of this cable being provided with couplings which are very simple and work automatically in the event of a train breaking in two. After the cars have been switched together the couplings are made between each car and finally connected with an ordinary electric bell and dry battery in caboose and engine. By referring to Fig. 1, it will be seen that by a pressure on the push button in the caboose, a circuit is completed through wires Nos. 1 and 2; this rings the bell in engine and caboose, and by a pressure on the push button in the engine a circuit is completed through wires Nos. 3 and 2, thus ringing the bells in both engine and caboose.

This enables the conductor to communicate to the engineer instantly and accurately, in accordance with a code relative to break downs, etc. It also permits the engineer to communicate with the conductor and advise him of an anticipated stop, so that he may protect the rear end of his train, as well as make other communications regarding the condition of the

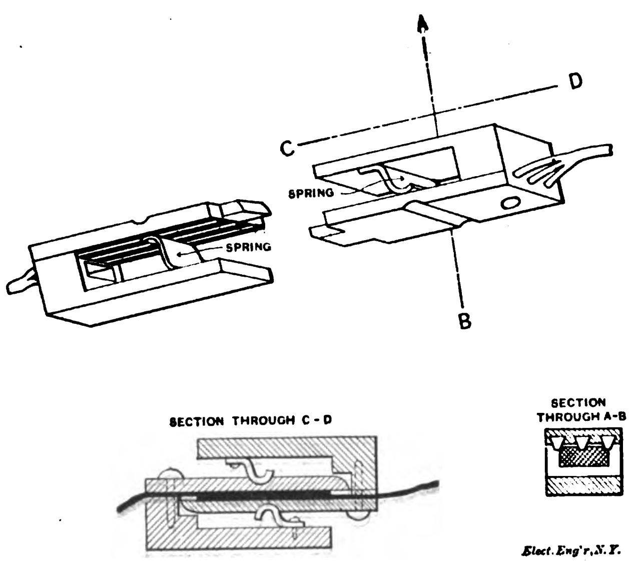


FIG. 2.—DETAILS OF FORD COUPLER.

cars near the engine, and at least save considerable time and avoid delaying trains.

In the event of a train breaking in two the wire coupling between the cars where the break occurs easily pulls apart, allowing the spring, shown in detail of coupler Fig. 2, to come in contact with the three wires, thus completing a circuit on the rear and through wires 2 and 3, which rings a bell in the caboose until the switch (shown on wire 3) is opened and circuit opened; and on the head end of the train the spring on the corresponding coupler comes in contact with wires and operates the same as on the rear end of the train, except that a circuit is completed through wires 1 and 2, which rings the bell in the engine until switch (wire No. 1) is turned and the circuit is thus opened. This enables both the engineer and conductor to know at once when a train parts, and they practically acknowledge receipt of this information by opening the electric switches to stop their bells ringing, and by adhering to the rules can prevent a collision of the detached parts.

The signal for passenger trains is exactly the same as for freight signal with the addition of a push button in each coach placed in the relative position to wires as shown in Fig. 2.

The one objection to this signal for freight train use will be that in the near future the law requiring all freight cars to be equipped with the "air brake" will be in effect. It is pointed out, however, that the practice of opening the air valve on the rear end of trains for the purpose of making an emergency stop, etc., is the prime cause of defective "draft rigging" and expensive repairs and delays to cars at terminal stations, and this can be avoided by use of a signal such as that described above.

BITTER STREET RAILWAY FIGHT IN ATLANTA, GA.

A special dispatch from Atlanta, Ga., of July 2 says: The contest between the city authorities and the Consolidated Street Railway Company, which has been in progress since the coming of the present administration took a sensational turn to-day, when it was learned that Mayor Collier will take steps to declare the company's charter void and the corporation illegal. The company, which controls nearly all the trolley lines in the city, is a combination of a number of car roads operated separately up to seven years ago, when the various corporations consolidated. Several months ago the city council passed an ordinance to compel the Consolidated to grant transfers.

The Old Colony Trust Company, of Boston, representing the bondholders, brought suit in the United States court to restrain the city from enforcing this ordinance. In an amendment which the city will make to its answer in that suit, the contention will be made that, having violated the provisions of the State constitution against the combination of competing railway lines, the Consolidated company's charter is null and void and the corporation an illegal one, without standing in court. The capital of the Consolidated is about $2,300,000, making the amount involved $4,300,000.

NEW STREET RAILWAY LAW IN MASSACHUSETTS.

A new law has gone into effect in Massachusetts, whereby the electric street railways come under the oversight of the State Board of Railroad Commissioners as they never have before. Heretofore, the railroad commissioners have had under their jurisdiction inspectors whose duty it has been to inspect the roadbeds, tracks, stations and rolling stock of the steam roads and also to investigate serious accidents upon the steam roads. Under the new law, which takes effect today, the inspectors are required to extend their examinations to the street railway lines as well, and in case any of the equipments of these lines are found not to be in compliance with the law, or in such a condition as to endanger the safety of the public or of the employés, the inspectors are to report in writing to the commissioners, who are empowered to take action. The inspectors are also required hereafter to investigate as promptly as possible any accident upon a street railway, attended by loss or risk of life, and to attend the inquests into deaths resulting from such accidents, and report the results of such investigations to the commissioners.

The State has been divided into districts and the several railroad inspectors assigned to different sections. The officials of the local street railways have received notice of the new law and its effects, from the railroad commissioners, but they do not regard it as of any great importance, as they consider that the inspections are likely to be of a more or less superficial nature and not of any particular value to the roads or to the public. The officials of the roads will cheerfully render the inspector any assistance possible in the performance of his new duties.

MONEY FOR NEW EQUIPMENT OF METROPOLITAN RAILROAD, NEW YORK.

The bonds issued by the Metropolitan Street Railway Company to raise the money for the equipment with the underground trolley of the lines on which that system will be used, are to be offered for public subscription this week. The issue is of $12,500,000 general mortgage 5 per cent. fifty-year gold bonds, secured by a lien on all of the company's property. The whole issue has been underwritten by a syndicate, and

only about $2,500,000 are said to be unsold. It is said that the bonds will be offered at 105 and interest.

THE POWER PLANT OF THE PIONEER ELECTRIC POWER COMPANY OF OGDEN, UTAH.

IN the canon of the Ogden River, near the city of Ogden, Utah, the latest and most important hydraulic power plant of that State, and one of the largest works of the kind yet undertaken in this country has been carried out during the past year by the Pioneer Electric Power Company of Utah. The city of Ogden is situated in the basin of the Great Salt Lake, at an elevation of 4,300 feet above sea level about 13 miles east of that body of water, and 35 miles north of Salt Lake City. The city extends eastward to the base of the Wahsatch Mountains, which tower 5,000 feet higher, reaching a total altitude of fully 9,000 feet above sea level. This chain of mountains is intersected by numerous deep valleys or canons, forming the outlet for drainage areas of considerable extent. The outlet of the narrow canon of the Ogden River is east of Ogden and distant about two miles from the business center. At a point about six miles above its mouth the gorge widens out into a valley, some eight miles long and four miles wide, surrounded by an almost continuous mountain chain. This valley is traversed by three streams which unite at the upper end of the canon to form the Ogden River.

The average annual rainfall in Ogden is 14 inches. In the Ogden Valley it is probably twice as great. The drainage area is about 360 square miles. The flow of the river varies greatly in different years and at different seasons. In May and June, when the snow on the mountains melts, a maximum flow of 4,800 cubic feet per second has been measured, while a minimum of 80 cubic feet in August and September is also on record. The minimum in average years is fully 125 cubic feet per second. The slope of the stream in the upper valley is comparatively gradual, while in the six miles of the canon there is a total fall of nearly 500 feet. This portion of the river has long appeared an attractive field for the development of power, but apart from a small saw-mill near its mouth

FIG. 1.—THE PIPE LINE ALONG THE SIDE OF THE CANYON.

there have been only abortive attempts made at utilizing the fall of the stream.

The plans of the Pioneer Electric Power Company contemplate the utilization of the waters of the entire Ogden River water shed above the mouth of the canon for the development of power as well as for irrigation. The central features of the plant are: A large storage reservoir and a masonry dam at the upper end of the canon; a pipe conduit 6 feet in diameter; a power house with water wheels and electric generators, electric transmission lines and substations for distributing the power to different points, and an extended system of irrigation canals.

The storage reservoir will cover an area of about 2,000 acres, and will have a capacity of nearly 15,000,000,000 gal-

FIG. 2.—EXTERIOR OF POWER HOUSE, SHOWING ONE VENTURI METER AND RECEIVER.

lons. It is formed by building across the canon, a short distance below its upper end, a dam of concrete masonry built up of isolated piers and arches founded on bed rock. The length of the dam on its crest is about 400 feet. It will have a total height of 100 feet, 60 feet of which will be above the level of the present river bed. The up-stream face is protected by a steel plate covering to prevent abrasion and percolation.

A 9-foot tunnel excavated through the solid rock around the south abutment of the dam forms the outlet for the water of the reservoir. At its upper end it connects to a masonry inlet tower, which is in turn connected by a riveted steel pipe 8 feet 6 inches in diameter with the main gate house, 100 feet below the tunnel. This contains two 72-inch valves, one controlling the supply of the main conduit, the other discharging the surplus water.

The main conduit is a pipe line 6 feet in internal diameter. Its total length is 31,600 feet, of which 27,000 feet is wooden stave pipe, and 4,600 feet at the lower end rivetted steel pipe. It is laid in a trench 8½ feet wide, and covered with earth to a depth of 3 feet on top. The selection of smooth wooden stave pipe in lieu of steel pipe throughout, was made on account of the greater cheapness of the former, as well as its less internal resistance to the flow. The pipe is laid along the side of the canon and follows the mountains to a point about half a mile beyond the mouth of the canon. It is built to conform to a hydraulic grade line of 2 feet per thousand, a slope believed to correspond to the friction in the pipe. At the upper end of the pipe the inlet is funnel shaped, and the wooden pipe is continuous except at three points where two rivetted steel elbows and a short length of tunnel are substituted. There are eight tunnels in the rock, the longest being 667 feet. There are also eight steel bridges with a total length of 560 feet besides a timber trestle. The maximum hydrostatic head in the wooden pipe is 117 feet, giving a pressure of 50 pounds per square inch.

From the end of the wooden pipe the steel conduit runs to the power house. The slope of this is quite steep and the

pressure is from 50 to 200 pounds per square inch. It is 60 feet in diameter until it reaches a point 100 feet from the power house, where it divides into two branches, 54 inches in diameter, which lead to two receivers, one on each side of the power house. There are 13 elbows in this pipe, and its entire weight is over 2,500,000 pounds. The total efficient head from the flow line of the reservoir when it is full to the center of the reservoir is 446 feet.

Between the inlet tower at the dam and the power house there are five large gate valves, besides the smaller blow-off and relief valves. Three are 6 feet in diameter, the other two 42 inches. The first two of the larger ones weigh about 23,000 pounds each and are in the gate house; the third is placed near elbow No. 2 of the steel pipe line about 100 feet below its junction with the wooden pipe. Its purpose is to permit the closing of the wooden pipe to keep it full of water even when the steel pipe is empty. The head at this point is about 200 feet. The valve has only a single valve stem and is operated by a hydraulic lift supplied with pressure water from the main pipe above the valve. The total weight of this valve is 52,000 pounds, the heaviest single piece in it weighing about 20,000 pounds. Besides these large valves there are two smaller, each 24 inches in diameter. These are placed between the lower end of the 6-foot pipe and the power house in the 54-inch branches leading to the receivers. These branches are reduced to 42 inches by the use of Venturi meters, thus permitting the use of the smaller valves, which are operated by hand. The pipe is fully provided with air, mud and relief valves. The connection between the main pipe and the branches is made by a breeches casting secured to the steel pipes by cast steel angle flanges and bolts. To withstand the great longitudinal pressure, a heavy concrete block is built around the casting. Of the nine bridges the longest is that over the Ogden River. This is a rivetted bow string girder 75 feet long. The other bridges carry the pipe line over lateral ravines or were built in place of masonry retaining walls, where a steel structure was cheaper.

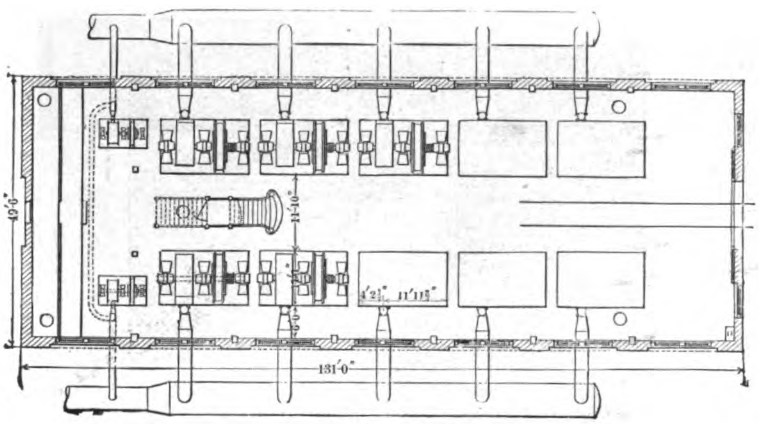


Fig. 3.—Plan of Power House.

The power house is built of pressed brick, with concrete and rubble footings, and cut stone trimmings. Its outside dimensions are 135 feet in length by 50 feet in width. The roof trusses are of steel, and are supported on steel posts imbedded in the brick walls. A traveling crane of 15 tons capacity, operated by hand power, traverses the building, the track girders being carried by the steel posts. This building contains all the hydraulic and electric machinery used. A smaller, separate building serves as a machine and blacksmith shop.

The water is delivered from the pipe conduit into two receivers, buried in the ground, one at either side of the power house. They are 6 feet in diameter and, in their general appearance and the material used, closely resemble the regular steel pipe conduit, the thickness of the metal, however, being increased to ⅞ inch in order to allow for the water hammer.

The receivers are provided with five safety valves each, which discharge when the pressure exceeds 200 pounds per square inch, and an outlet gate at the bottom. From each of these receivers, five 30-inch and one 10-inch, intake pipes extend to the walls of the power house to connect with the water wheel nozzle pipes. Between these intakes and the nozzle pipes are placed the following valves in the order named: One 18-inch geared gate valve, one 18-inch hydraulic gate valve and one 18-inch butterfly valve.

The 18-inch geared gate valve is only to be used in case of repairs to the particular machines that govern it. The 18-inch hydraulic gate valve is piped up to a small D valve, which is placed back of the switchboard and under the floor. By means of a lever on the switchboard, connected to this D valve, the gate can be opened or closed at the operator's will. This valve is the one which is to be used for starting or stopping a wheel. The 18-inch butterfly valve is operated by means of a worm gear from the governor, and is used in checking the speed of the wheel by reducing the head or pressure near the nozzle and thus avoiding a sudden fall of head in the main pipe which would be detrimental to the proper working of the plant.

The nozzle for the water wheels has six rectangular openings or ports 1 11-16 x 3½ inches in area, of which the operator is able to close one or more as he may desire. The levers that operate the hydraulic gate and nozzle are placed near the top of the switchboard. The set of levers for each water wheel is placed in the panel governing the generator which is driven by the wheel in question, so that the operations required in starting or stopping these machines are reduced to a minimum. The wheels are of the impulse type directly connected to the generators. The complete plant will consist of ten units, five being already installed. The power house and receivers being built for the ten, the balance can be readily installed at any time.

The Knight water wheels are 59 inches in diameter and have 45 bronze buckets cast in one solid piece; 14 of these will, when the nozzle ports are all open, receive the water at the same instant. The centers of the wheels are made of cast steel, the buckets being pressed on these steel centers and secured with bolts. These wheels are keyed to the generator shaft. Each wheel has a capacity of 1,200 horse-power at 300 revolutions per minute, and each is provided with two flywheels, about 70 inches in diameter, each weighing about two tons.

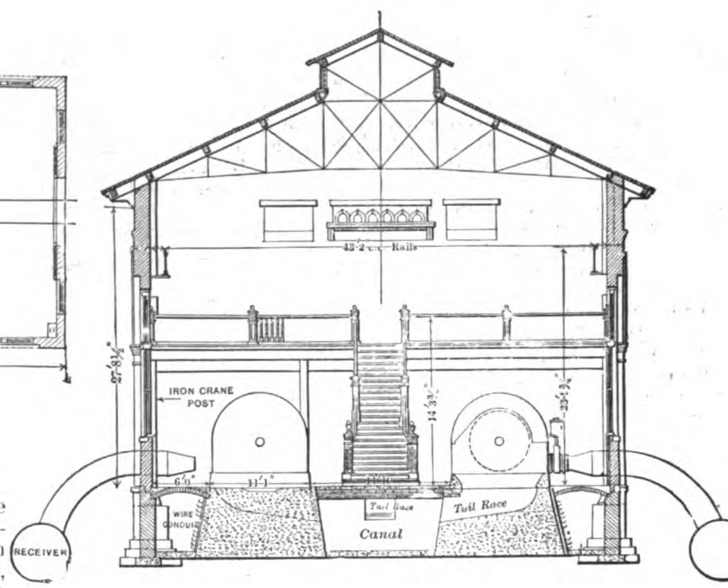


Fig. 4.—Section of Power House.

The armature, armature shaft, two fly-wheels and one water wheel, which comprise the moving parts, weigh 15 tons. This allows a uniform speed to be maintained notwithstanding changes of head in the main pipe, or changes in the generator load. The water wheel, fly wheels, nozzle and the two hydraulic cylinders controlling the nozzle ports are encased in a steel housing, bolted to the machine bed frame.

Between the two lines of machines and down through the center of the building underneath the concrete floor is the spillway into which the wheels discharge the water, and through which the water is carried back to the river from which it is taken.

The generators used in this plant are of the General Electric Company three-phase type, with 24 poles, and at 300 revolutions per minute, have an output of 750 kilowatt at 2,300 volts, and a frequency of 60 cycles per second. The factory tests show that the variation in volts will be less than 5 per cent. with a constant speed, should the full non-inductive load be thrown off or on.

Between the machine foundations and the building foundation wall, on each side of the building, is a subway which runs the entire length of the building and across the rear, and in this subway are carried all the necessary piping for water wheel controllers and all the wires between the generators and the switchboards. The cable connecting each

generator to its respective panel on the generator switchboard is a three-wire concentric 250,000 C. M. lead-covered cable, and the exciting wires are a two-wire concentric No. 4 B and S lead-covered cable.

The exciters used on this plant are G. E. six-pole 500 volt machines, and will give 100 kilowatt at 550 revolutions per minute. Each of these machines is ample for the entire exciting current that will be needed for the ten 750 kilowatt alternators, and they are each direct connected to a 135 horse-power Knight water wheel, similar to the 1,200 horse-power water wheels previously described. These exciter water wheels are cross-connected to each receiver, so that either exciter can be operated from either receiver.

The generator switchboard consists of seven marble panels; five for the alternators, one for the exciter and one for the instrument panel.

These panels are 26 x 90 inches each. They are built up of blue Vermont marble, with nickel fittings. There are two sets of three-phase bus bars on the back extending the entire length of the seven panels, as well as two bus bars, also running their entire length, from which the exciting current is taken.

From the generator switchboard the current is carried to the distributing board over copper bars, of which there are two sets of three, connecting the two sets of bus bars on the generator board with the two sets of bus bars on the primary panels of the distributing boards.

The distributing board is in a gallery in the rear of the building and over the generator switchboard. Back of this distributing switchboard are nine 250 kilowatt air blast step-up transformers, the lightning arresters, and the two blowers for cooling the transformers. The distributing board is divided into two sections—the primary section and the secondary section.

Back of the distributing switchboard and on a raised platform are placed the step-up transformers. These transformers raise the potential of the current from 2,300 to 16,100 volts, at which pressure it goes on to the long distance transmission lines. The transformers are connected up in sets of three, the delta connection being used on both sides. At each end of the building in the gallery are placed the two blowers, direct connected to a 2½ horse-power 500 volt direct current motor. These blowers are used in cooling the step-up transformers, and force the air up through the bottom of the transformers, around the coils and out at the top.

The transmission line is calculated to deliver about 3,000 horse-power at the sub-station in Salt Lake City, distant about 38 miles, and consists of two circuits, making six wires of No. 1 B and S gauge.

The poles used on this line are of Oregon cedar, and are good, clear, straight poles, 30, 40, 50 and 70 feet long, with 9-inch and 10-inch tops. There are two cross arms on each pole for the wire; two wires are on the top arm 4 feet apart, and four wires on the bottom arm, each 2 feet apart, a circuit being on each side of the pole. These wires are so arranged that should a plane be placed perpendicularly across the circuit it would show an equilateral triangle, with a wire at each angle, the length of the sides being 2 feet. These wires are transposed about every half mile. By this arrangement of the pole line wire, the inductive effect is reduced to a minimum.

About 6 feet below the second cross arm on the pole is a two-pin cross arm, on which the telephone wires are strung, being transposed about every four poles, there being an average of about 50 poles per mile.

The current is fed into the transmission line at the power plant at 16,100 volts and delivered to the step-down transformers at 13,800 volts. This will give an energy loss of about 10 per cent. in the line, and a potential loss of about 14 per cent. The substation step-down transformers deliver this current to the local distributing lines again at 2,300 volts. There are at present nine 250 kilowatt step-down transformers at the substation connected by the step-up transformers, and the switchboard in the substation is similar in every respect to the distributing board in the power plant gallery. The cooling apparatus here is also identical with that used in the power plant, except that the motors used are 60 cycle induction motors.

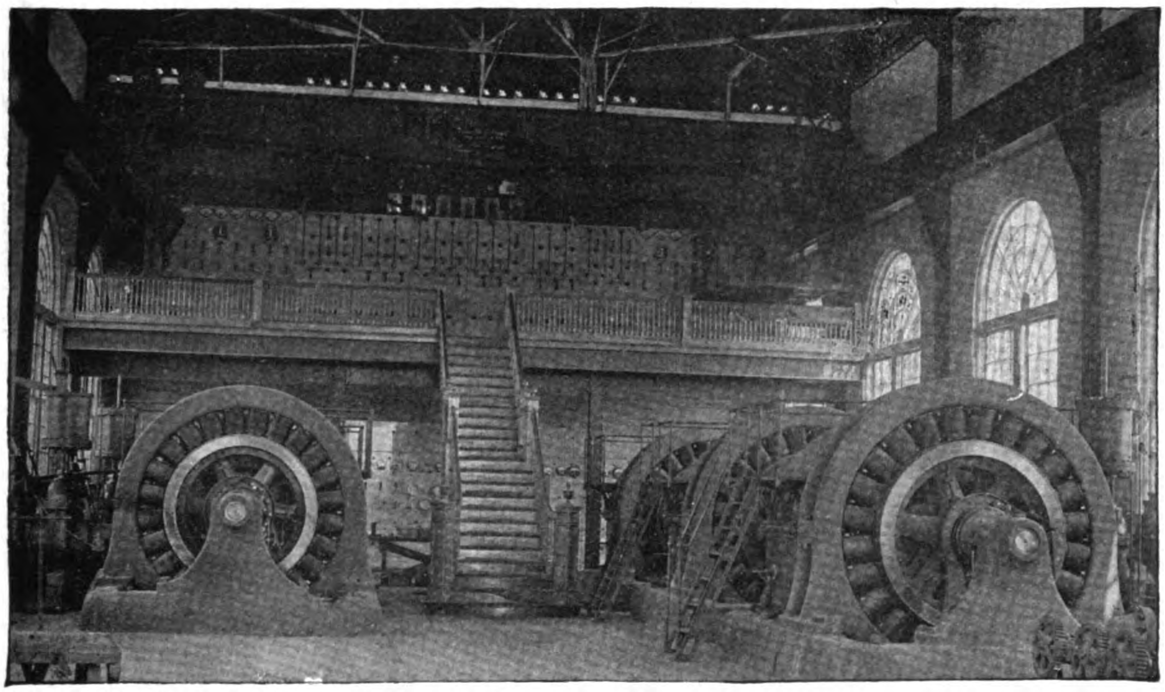


FIG. 5.—INTERIOR OF POWER HOUSE.

While the transmission lines are at present capable of delivering 3,000 horse-power at the substation, with a 10 per cent. energy loss, if it should become necessary, the step-up transformers can deliver more than this by changing three wires on their high pressure side, and delivering the current into the transmission lines at 27,000 volts. Thus the line capacity would be more than doubled.

The present installation of the power plant is capable of delivering 3,750 kilowatt to its lines, but ample provision has been made to increase this amount to 7,500 kilowatt by installing five more 750 kilowatt machines, as new industries or manufacturers spring up as the rsult of the advantages offered to them in Ogden and Salt Lake City.

There is one important feature in the arrangement of the machinery which should be noticed, viz., the complete duplication of all parts. All portions of the plant below the breeches pipe casting, at the lower end of the 6-foot conduit, are absolutely symmetrical about the center line of the power house, each side being entirely independent of the other. This applies not only to the pipe and the receivers, but to all the parts of the switchboards, etc., as well as to the generators and water wheels. Either one of the exciters, also, is capable of providing sufficient current for all the large generators, and can be run with water from either receiver. The advantage of this arrangement is that an accident to either receiver, or to one or more wheels or generators, would not result in the shutting down of the entire plant, but at the

worst of only one side. For a short period all the required power could probably be supplied from one side of the power house.

The current will be used to drive factories, running electric railways from Ogden to Salt Lake City, to the Lake, to Hot Springs and to light the towns and cities in the north of the State. The surplus water in the storage reservoir will be utilized to irrigate large tracts of land in the vicinity.

The Pioneer Electric Company was organized November 27, 1893. The president and treasurer of the company is the Hon. Geo. Q. Cannon, the head of the Mormon Church. The general manager is Frank J. Cannon, son of the president and United States Senator from the State of Utah. The directorate consists of W. Woodruff, president of the Mormon Church, Joseph F. Smith, one of his counselors, F. D. Richards, one of the apostles, Asahel Woodruff and A. B. Patton, president of the Ogden Chamber of Commerce; Mr. Patton and the chief engineer and secretary, Mr. C. K. Bannister, are the only men among the directorate not members of the Mormon Church.

The conception and successful completion of the works belonging to the Pioneer Electric Power Co. are largely due to the efforts of C. K. Bannister, C. E., who, as chief engineer and secretary of the company, has devoted several years to the careful study of the engineering and financial problems involved.

MECHANICAL

THE WORTHINGTON TWIN CYLINDER VERTICAL CONDENSER.

THE new special catalogue just issued by Henry R. Worthington contains descriptions of that well known firm's three types of condensers, among them the twin cylinder vertical condenser shown in the accompanying engraving. This is the result of the demand for an air pump and condenser to occupy the least possible floor space, and still have all its internal parts easily accessible, that has led to the design and construction of the Worthington twin cylinder vertical condenser, which represents the latest advancement that has been made in this class of apparatus. The accompanying engraving shows the pump with the condensing chamber removed. This chamber is usually placed at the rear and connects directly with the channel plate at the bottom of the pump. The opening in front is for the discharge water.

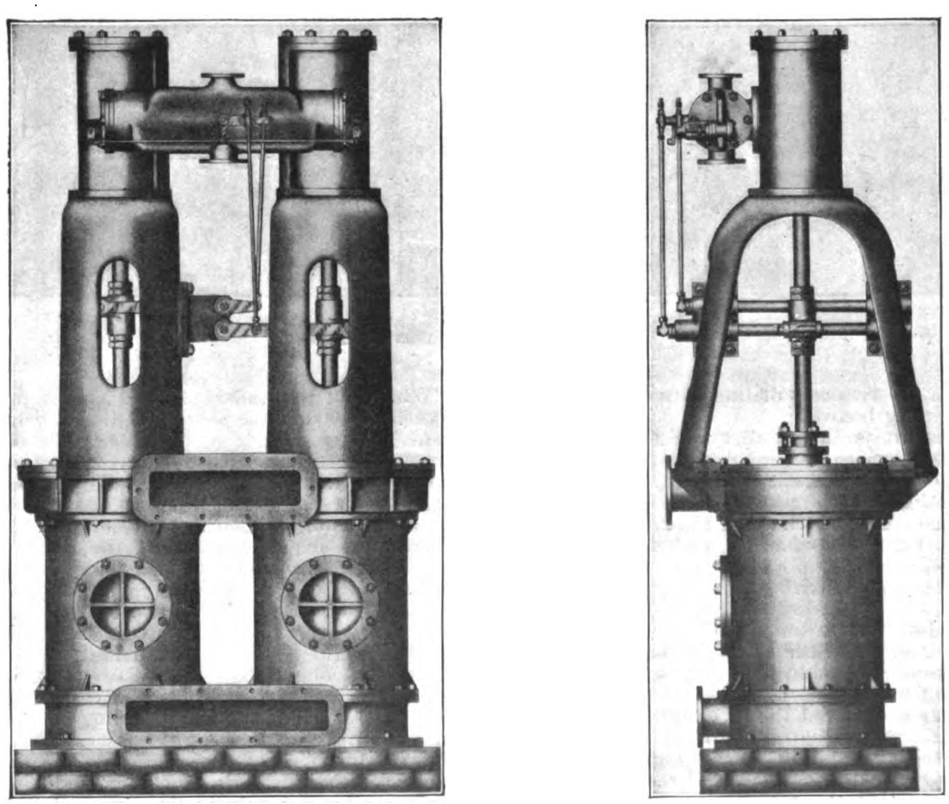
Each side of the pump is, of course, single-acting, the buckets being of the form used for years in attached air pumps on both marine and stationary engines. As one side goes down and does but practically little work, it is important that the other side should make an up-stroke at the same time and do full work in evacuating the condenser to which the suction of the pump is attached. The valve motion applied to the Worthington twin cylinder vertical air pump and condenser has the novel and valuable function of giving to the buckets the same constancy of action as would be obtained if they were rigidly connected by a beam, but with the advantage of an entire absence of side thrust such as is caused when a beam passes its center. The power of the steam pistons is transmitted directly through the piston rods to the air pump buckets, thus doing away with the beam, etc. There are thus no links, sliding cross-heads, gibs, keys nor journals to adjust, and an important saving in weight is accomplished.

The stroke of this pump is positively determined by the valve motion and neither bucket can begin a return stroke until the other bucket has entirely completed its stroke.

A feature of still greater importance is found in the fact that each air pump bucket pauses at the end of the downstroke and allows its bucket valves to close before the upstroke begins. The other bucket, however, during this pause, is still traveling upward and doing full work, so that there is no remission of effectiveness from this action.

The condensing chamber being attached to the channel plate or base of the air pump permits a reduction in the vertical distance from the foundation or floor line to injection opening, which is a substantial benefit in locations where it becomes necessary to place the condenser at an elevation considerably above the level of the water in the well. In such cases the adoption of this form of condenser materially reduces the total suction lift without necessitating changes or alterations in the plant.

On the other hand, it is frequently desired to place the condensing apparatus in a pit, and the Worthington vertical twin cylinder condenser is particularly well adapted to such locations; since the throttle, injection and regulating valves are all placed above, the condenser can be conveniently operated from the engine room floor. The most satisfactory and



WORTHINGTON TWIN CYLINDER VERTICAL CONDENSER.

gratifying results have been obtained with this form of condenser.

GAS FOR POWER PURPOSES.[1]

BY JOSEPH EMERSON DOWSON, M. Inst. C.E.

GAS engines driven with ordinary town gas offer the following advantages compared with steam engines: No ground space for a boiler is required, and no chimney; there is no boiler to clean and repair, and no boiler insurance; there are no clinkers and ashes to remove and no fireman to pay; the gas engine can be stopped or started at will, and there is no loss of fuel during the stand-by hours. Besides all this, there is the important fact that there is always a large storage of power to fall back on in the gasholders at the gas works. For intermittent work, such as hoisting, printing, etc., and for moderate powers working constantly, gas engines driven by gas taken from the town mains have such manifest advantages that to a large extent they have superseded steam engines, and will doubtless continue to do so. Almost the only drawback to the use of town gas is its cost, but in some places the day pressure in the mains is too low and gives trouble. It is generally admitted that when town gas costs more than 3s. per 1,000 cubic feet, the working cost of an engine indicating more than about 30 h. p. exceeds that of a steam engine of the same power, under the usual conditions of regular working.

For larger powers it is now usual to work a gas generating plant in connection with the engine, or there may be several engines served by one gas plant. In such cases the gas plant is to the gas engine what the boiler is to the steam engine. Approximately it occupies about the same ground space as a steam boiler of the same horse-power, and the fireman is of the same type in each case. With the gas plant there is no need of a chimney stack; but in towns or where there are adjoining houses it is desirable to have a small waste pipe from the generator carried up above the level of the roofs, so that when the fire in the generator is blown up after standing, the gases then formed may be blown off without nuisance. The repairs of a gas plant usually cost much less than the cleaning and repairs of a boiler for the same power. The first engine driven with generator gas was in 1879, and since then the adoption of this system of power has spread so rapidly in all countries that it is now quite impossible to estimate the numbers in use. The general outcome is that engines of good make (indicating 50 h. p. and upward), driven by generator gas of average quality, consume about 1 lb. of fuel, whereas good steam engines require 2 lb. to 3 lb. per i. h. p. hour.

An engine indicating about 120 h. p. has been run on test for five hours, with an actual fuel consumption of only ¾ lb. per i. h. p. On another occasion, with an engine indicating under 33 h. p., the gas plant was placed on a weighing machine, so as to obtain a series of actual records of the weight of fuel converted into power, and even on this small scale of working the fuel consumed was only 1.2 lb. per i. h. p. hour.

MARRIED

MILLER-KNOWLTON.

The wedding of Miss Antha Knowlton, daughter of Mrs. Knowlton, to Kempster Blanchard Miller, took place on Saturday, July 3, at 1807 Wesley avenue, Evanston, Ill., the residence of Mr. James E. Keelyn, president of the Western Telephone Construction Company, of Chicago. The Rev. Dr. Henson, of the First Baptist Church of Chicago, performed the ceremony, after which the bride and bridegroom started on their wedding trip to California, and will be away for about a month. Mr. Miller, who has been associated with the Western Telephone Construction Company for some time past, is a great favorite amongst the electrical fraternity in the West, and has the best wishes of his many friends for his future happiness, and that of his bride.

WASHINGTON, MO.—Mr. A. A. Tibbe, the proprietor of the Washington electric light plant is putting in a telephone exchange, which will connect with several neighboring towns.

[1]Paper read at the Institution of Civil Engineers. Engineering Conference.

LITERATURE

ELECTRIC POWER TRANSMISSION.—By Dr. Louis Bell. New York: W. J. Johnston Company, 1897. 491 pp.; 6 x 9 in. Cloth. Price, $2.50.

THIS is an excellent treatise on power transmission written by an accepted authority on electrical transmission of power. The chapter on properties of alternating current brings out with remarkable clearness without the use of mathematics, the somewhat involved effects which arise in the transmission of those currents. Under the section devoted to the commercial problem the author sounds a warning which none notes more keenly than the professional man. Regarding the questions of published costs, it may be said that they are very misleading in their direct application to practical problems, as they are usually a statement of only part of those expenses that are really incurred in power production. The upbuilding of electric plants promoted from such costs as a basis has placed the electric light and power industry in its present state of financial coma.

On the other hand, Dr. Bell, in his comparative estimate of power transmission where rope, pneumatic, pneumatic reheating and electric have been compared, has assumed the cost per year at $18 per indicated horse-power. He has based his assumption on good authority, but when we turn to actual production of the steam power horse-power per year we find that practical conditions would be more nearly approximated if a much higher figure were assumed. The cost given is for horse-power under practically 100 per cent. load factor, which is not the condition under which transmission plants operate.

As the treatise relates largely to water power developments, if $18 per year per i. h. p. can be practically realized, it limits largely the water powers which can be developed to produce a power in competition with $18 per year with steam. The development expense of the water power, and the distribution expense of the electrical energy must both be small, and the operating expense must be low in order to have a margin of profit over the assumed $18 per year, as the equality basis. This assumption does not affect largely the relations of efficiencies established by him for the various systems, because two miles is the distance assumed and is outside the profitable range of rope transmission. It is a very doubtful problem for pneumatic. Dr. Bell has only touched on one formidable opponent to electrical transmission at short ranges, and that is gas transmission for power distribution purposes and where coal is the available supply of energy. This method is the only one equitably comparable with electric transmission at two miles.

Beyond these points Dr. Bell has elucidated the problem of electric power transmission in a manner for which the profession as well as investor owes him a debt of gratitude.

H.

THE AURORA BOREALIS. By Alfred Angot. New York: D. Appleton & Co. 1897. Cloth. 12mo. Illus. 264 pp. Price, $1.50.

There is not a great deal of literature on this interesting subject, and a book so full of information as this is, therefore, very welcome. The still mysterious phenomena of the polar aurora are here analyzed and criticised; and the probability that auroras are produced by electrical discharges in very rarefied air is discussed from the different standpoints of theory and test. A valuable portion of the book is the catalogue of auroras seen in Europe below lat. 55 from 1700 to 1890. The plates of auroras are in black and white, and some of them are striking enough to make us wish for their reproduction in color, like those in Nansen's "Farthest North" from the explorer's own water colors.

PERSONAL

MR. LOUIS A. FERGUSON, of the Chicago Edison Company, who has been confined to his home for some two weeks past with a severe attack of stomach trouble, is now on the high road to full recovery, and his many friends will be glad to learn that he is able to attend to business.

EDUCATIONAL

McGILL UNIVERSITY, MONTREAL.

The Faculty of Applied Science has just issued its announcement for the session 1897-8 in a pamphlet giving in succinct, complete form all the information required by those desiring to become students or by those at all interested in the work. McGill has a magnificent equipment, an excellent teaching corps, and the conditions in Montreal are very favorable for students in the arts and sciences. The tuition fees at the University are moderate, and the apparatus placed at disposal for experimental work is probably as complete as that to be found anywhere on this continent—in some respects unequaled.

IOWA STATE UNIVERSITY.

We regret to note that the Library of the State University of Iowa, at Iowa City, has been almost entirely destroyed by fire. Mr. J. W. Rich is the librarian.

SOCIETY & CLUB NOTES

BOSTON N. B. OF ELECTRICAL WORKERS.

At the regular weekly meeting of Local Union No. 35, of Boston, National Brotherhood Electrical Workers of America, held at their hall, No. 49 Bennet street, Boston, Wednesday, June 30th the following officers were elected and installed: President, J. A. MacInnis; vice-president, D. B. Smith; recording secretary, D. A. McGillivray; financial secretary, R. H. Bradford; foreman, M. J. Sheehan; inspector, Wm. Hubbard; trustees, A. L. Sprague, J. M. Costello, J. J. Larkin; press secretary, J. F. Phelps.

Local No. 35, of Boston, is one of the largest and strongest locals of the National Brotherhood. At the present time there are two hundred and fifty members in good standing. They are affiliated with the Federation of Labor, Building Trades Council and the Central Labor Union of Boston. They have recently acquired new permanent quarters at No. 49 Bennet street, and their doors are open for the admission of all bona fide electrical workers.

CINCINNATI ELECTRICAL CLUB.

The regular monthly meeting of The Electrical Club was held on Thursday, July 1, at the club room in the College Building. Mr. H. S. Rogers, Division Engineer of the General Electric Company, presented a very interesting paper on the monocyclic system, in which he set forth in a very clear manner the various systems of alternating current transmission now in use, together with the advantages and disadvantages of each. The club has decided not to hold the regular monthly meetings during August or September, but the club room will be open at all times to members. Hugo Diemer is secretary.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE fourteenth general meeting of the Institute will be held at Greenacre-on-the-Piscataqua, Eliot, Me., on July 26, 27 and 28. The opening session will be held at 2 p. m., on Monday, July 26. The following papers will be presented: The Precision of Electrical Engineering. Inaugural address, by the president, Dr. Francis B. Crocker, of New York City. The Alternating Current Induction Motor, by Charles Proteus Steinmetz, of Schenectady, N. Y., A New Form of Induction Coil, by Prof. Elihu Thomson, of Lynn, Mass. Effect of Heat upon Insulating Materials, by Putnam A. Bates and Walter C. Barnes, of New York City. The Effect of Armature Inductance upon the Electromotive Force Curves of an Alternator, by Prof. W. E. Goldsborough, of Lafayette, Ind. Electric Metering from the Station Standpoint, by Caryl D. Haskins, of Boston, Mass. Development of the Fire Alarm Telegraph, by Adam Bosch, of Newark, N. J. Electrical Traction—Notes on the Application of Electrical Motive Power to Railway Service, with illustrations from the Practice of the Metropolitan Elevated Road of Chicago, by M. H. Gerry, Jr., of Chicago. The Cost of Steam Power, by Horatio A. Foster, of Buffalo, N. Y. Efficiency and Life of Carbons in Enclosed Arc Lamps, by W. H. Freedman, of New York City. Armature Reactions in a Rotary Transformer, by Prof. Robert B. Owens, of Lincoln, Neb. Recent Applications of Storage Batteries to Electric Railways, by Herbert Lloyd, of Philadelphia. The Economy and Utility of Electrical Cooking Apparatus, by Prof. J. P. Jackson, of State College, Pa.

In addition to the regular Institute programme, Miss Farmer has arranged for some special popular meetings and lectures on electricity and invention, in special remembrance of her father, Prof. Moses G. Farmer. Among the expected participants are Prof. Brackett, on The Past and Present Outlook of Electrical Science; Prof. Dolbear, on Moses G. Farmer as an Electrical Pioneer; Prof. Elihu Thomson, on Electricity in the Future; Prof. Anthony, on the Education of Electrical Engineers; Mr. T. Hall, on Early Electric Traction; Mr. F. J. Sprague, on the Richmond Road; while Profs. Crocker, Louis Duncan, Pupin and C. R. Cross will also participate. Secretary Pope is now issuing programmes to all the members. Copies can be had on application.

LEGAL NOTES

WENSTROM ELECTRIC COMPANY.

The Wenstrom Electric Company has filed its answer in the Circuit Court, Baltimore, by Steele, Semmes, Carey & Bond and H. Marcus Denison, attorneys, to the suit instituted by C. C. Shriver for the sale of the company's property. It is asserted in the answer that the leasing of the company's property was a wise and judicious proceeding, and that the company discontinued the active prosecution of its business because of this lease, and not because of insolvency or financial embarrassment. The answer denies that the company's factory has been abandoned or allowed to remain in a neglected condition. The company's entire indebtedness, the answer claims, is about $5,500, and its property and franchises are worth about $250,000, so that in no sense is the company insolvent.

MISSOURI CO.'S PLANT IN ST. LOUIS NOT A NUISANCE.

In the case of Annie Chamberlain against the Missouri Electric Light and Power Company, the jury found a verdict in favor of the defendant. The plaintiff owns a row of houses on Olive street, near Twentieth, nearly opposite the power plant of the defendant. She claimed that the noise, smoke and vibration of the earth caused by the defendant's plant have damaged her property, and that they cause her tenants to become dissatisfied and leave the premises. She sued for $15,000 damages. The contention was that the plant was run with due care and that it was in no sense a nuisance or detriment to the neighborhood.

THE STOCK MARKET

SPECULATION NARROW.

MIDSUMMER dullness now rests upon the markets, but with a smaller volume of business and a narrowing speculation, prices are firm. Some attention is being paid to the coal miners' strike and the effect of a short supply, but in general hopefulness prevails of an early settlement. Recently 25 per cent. of all the union engineers in England were out on strike, but the markets were all indifferent to it. The Western crop prospects are excellent and above the average. Gold exports have stopped, and early importations are looked for. General trade is quiet; the merchants all say: "What we want is orders."

Last week, 13,395 shares of Western Union were sold, closing at 84. Only 1,725 shares of General Electric changed hands, touching 34. American Bell Telephone on sales of only 513 shares was steady around 228.

COPPER: Lake copper is quoted in carload lots at 11½ cents; Western at 11¼.

RAILS: Heavy steel rails are quoted at $19 and light at $24 to $28.50.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 29, 1897.

Alarms and Signals:—

BURGLAR ALARM SYSTEM. W. T. Arnold, Chicago, Ill. Filed December 15, 1896.
A system in which objects are protected by movable covers.

ELECTRIC TRAIN SIGNAL. M. W. Parrish, Detroit, Mich., 585,342. Filed November 7, 1896.
Comprises a signal, and a muffling armature, and a permanent magnet for locking the armature.

Batteries, Primary:—

APPARATUS FOR APPLYING HEAT TO THERMO BATTERIES. H. C. Reagan, Jr., Philadelphia, Pa., 585,229. Filed May 15, 1896.
In combination with a locomtive boiler with a smoke box, a thermo battery surrounding the smoke box, a cooling device surrounding the battery and means for causing a circulation through the device.

Batteries, Secondary:—

SECONDARY BATTERY. G. E. Hatch, Quincy, Mass., 585,472. Filed April 28, 1896.
Consists in autogenously forming a porous layer of active material from the metal of the electrode by electrolytic action, then loosely confining against the porous layer, active material in a granular condition, and continuing the electrolytic action so as to effect the union of both materials.

SECONDARY BATTERY. G. E. Hatch, Quincy, Mass., 585,473. Filed April 28, 1896.
Employs terra cotta supporting plates.

ELECTRIC ACCUMULATOR SYSTEM. H. B. Cox, Hartford, Conn., 585,620. Filed Nov. 10, 1893.
System for charging a plurality of accumulators from a generator of lower voltage than the voltage of the accumulator plant by successively placing one or more of the accumulator cells in circuit with the generator for a predetermined period of time.

Conductors, Conduits and Insulators:—

EARTH CONDUCTOR OR GROUND WIRE ATTACHMENT. H. M. Crane, Boston, Mass., 585,185. Filed May 10, 1897.
A connector for attaching an electric conductor to a pipe, consisting of a metal band looped around the pipe, in combination with a holding device through which the loop passes in close contact with the pipe.

ELECTRIC CONTACT DEVICE. S. H. Stahl, Johnstown, Pa., 585,293. Filed February 23, 1897.
Comprises a plurality of spools adapted to engage opposite sides of the conductor, a jointed frame upon which the spools are carried, and a compression device adapted to exert a separative pressure upon the ends of the frame.

INSULATING JOINT. L. F. Van De Wiele, Brooklyn, N. Y., 585,321. Filed October 14, 1896.
Comprises a yoke, two insulating disks fitting upon each other, a hickey fitting between the disks insulated from the binding pin and yoke, and a binding pin carrying the insulating disks in the yoke.

Dynamos and Motors:—

COMBINED ELECTRIC FAN AND ELECTROLIER. E. H. Bennet, Jr., Bayonne, N. J., 585,250. Filed June 14, 1893.
Consists of a central shaft, supporting an electric motor, and having a portion which is revoluble thereon and which carries fan blades, and an electrolier regidly supported by the shaft and comprising a plurality of electric lamps.

DYNAMO ELECTRIC MACHINE. G. E. Dorman, Chicago, Ill., 585,379. Filed February 4, 1896.
Single phase alternating current motor.

ELECTRIC MOTOR. C. Lindberg, Duluth, Minn., 585,527. Filed February 24, 1896.
Iron clad motor adapted for the propulsion of cars or other vehicles.

ELECTRIC DYNAMO OR MOTOR. C. E. Emery, Brooklyn, N. Y., 585307. Filed April 20, 1893.
Consists of an electric dynamo or motor without field coils based on the development of the discovery that the operation of shifting the commutating brushes from mid-position through a given angle of commutation has the effect to produce a field across the armature and through the pole-pieces and yoke.

Electro-Metallurgy:—

PROCESS OF OBTAINING METALLIC ZINC AND COPPER FROM ORES. C. A. Burghardt and G. Rigg, Manchester, England, 585,355. Filed June 1, 1896.
Consists in treating the ores with an ammoniacal solution precipitating the iron dissolved in the resultant liquid by the addition of hydrated oxid of tin and recovering the zinc electrolytically.

ELECTROLYTICAL DIAPHRAGM. C. Kellner, Vienna, Austria-Hungary, 585,387. Filed August 18, 1894.
A diaphragm for electrolytic apparatus composed of a slab of soap and a suitable reinforcing backing.

METHOD OF AND APPARATUS FOR SEPARATING PRECIOUS METALS FRO MTHEIR SOLVENT SOLUTION. J. F. Webb, St. Louis, Mo., 585,492. Filed September 21, 1896.
Consists in passing the solution first in a downwardly direction through a body of carbon, then in an upwardly direction through a body of zinc, and then downwardly again through a body of carbon.

PROCESS OF OBTAINING POROUS METALS BY ELECTROLYSIS. L. Hopfner, Berlin Germany, 585,359. Filed October 5, 1896.
Consists in electrically precipitating a porous metal, and stiffening the same by precipitating thereupon a denser metal.

Lamps and Appurtenances:—

BRACKET FOR INCANDESCENT LAMP. H. Noreck, Charlottesville, Va., 585,350. Filed March 5, 1897.
Comprises a tubular section through which the wires extend and an overlapping guard forming a hood adapted to receive the socket.

ELECTRIC ARC LAMP. C. J. Toerring, Jr., Washington, D. C., 585,603. Filed January 2, 1896.
Feed mechanism for enclosed arc lamps.

ELECTRIC ARC LAMP. P. H. Klein, Jr., New York, 585,316. Filed March 20, 1897.
Air tight joint for attaching the lower carbon in enclosed arc lamps.

ELECTRIC ARC LAMP. P. H. Klein, Jr., New York, and E. Lavens, Brooklyn, N. Y., 585,317. Filed November 9, 1896.

ELECTRIC ARC LAMP. E. Lavens, Brooklyn, N. Y., 585,318. Filed March 20, 1897.
Similar to No. 585,316.

Measurement:—

ELECTRIC METERING APPARATUS. E. P. Cox, Lynn, Mass., 585,258. Filed March 6, 1897.
Comprises apparatus having a number of registering devices, one part of which is always connected to the motor mechanism and registers the whole amount of energy used, and means for throwing the other part of the registering device out of and into operation at predetermined times.

ELECTRIC METER. E. P. Cox, Lynn, Mass., 585,257. Filed March 6, 1897.
Comprises a meter for registering at different times, consisting of a single motor mechanism and single registering mechanism, and means for controlling the speed of the motor for a given load from a point distant from the meter.

Miscellaneous:—

ELECTRIC CLOCK. R. Baumann and T. H. Wurmb, St. Louis, Mo., 585,249. Filed May 18, 1896.
Consists of an electromagnet provided with a rocking armature, having a side pull and which operates through its connections the hands of clocks, at times determined by a master clock.

GROUND DETECTOR. E. W. Rice, Jr., Schenectady, N. Y., 585,287. Filed March 1, 1897.
An instrument of the static type for alternating circuits.

ELECTRIC TOWER CLOCK. T. H. Wurmb and R. Baumann, St. Louis, Mo., 585,301. Filed May 18, 1896.
Details of construction.

Electric Heating:—

ELECTRIC BROILER. G. B. Fraley, Denver, Colo., 585,308. Filed October 28, 1896.
Employs a rotatable shaft on which the broiler is supported, suitable bearings for the shaft and means for conducting electricity to the broiler in whatever position it may assume.

ELECTRIC HEATER. G. B. Fraley, Denver, Colo., 585,309. Filed October 28, 1896.
Comprises a block having a channel therein, elements of conductive material located in the block, a chamber in the rear of the channel, and in communication with the latter, and means for causing the elements to always contact with each other.

ALTERNATING CURRENT ELECTRIC HEATER. G. B. Fraley, Denver, Colo., 585,310. Filed April 27, 1897.
Comprises a closed circuit secondary coil surrounded by a primary coil in inductive relation to it, and means for putting the latter in circuit with a source of alternating current.

ELECTRIC HEATER. G. B. Fraley and A. B. Paulson, Philadelphia, Pa., 585,311. Filed September 21, 1896.
Adapted for use with either direct or alternating currents.

Railways and Appliances:—

CONTACT BOX FOR ELECTRIC RAILWAYS. W. M. Brown, Johnstown, Pa., 585,255. Filed July 18, 1896.
Employs a sealed vessel removably secured within the box containing a switching mechanism consisting of a solid conductor floating or immersed in a liquid conductor.

ELECTRIC TROLLEY DEVICE. A. J. Gairing, Johnstown, Pa., 585,267. Filed December 26, 1896.
Comprises diverging upwardly pressed arms, a guide, a post adapted to slide in the guide, and pivotal connections from the post to the diverging arms.

TROLLEY GUARD. W. C. Dunham, Indianapolis, Ind., 585,380. Filed December 27, 1895.
A device provided with fingers and located alongside the wheel with its catching-face normally below the groove in the trolley wheel and arranged to rise above the groove by force imparted from contact with the wire after catching it.

TROLLEY FOR ELECTRIC CARS. J. C. Kellogg, Lexington, Ky., 585,579. Filed September 25, 1896.
Embodies upwardly flaring arms pivotally connected intermediate their ends to the trolley axle and adapted to engage the wire when the trolley leaves it.

TROLLEY FOR ELECTRIC RAILWAYS. V. Thelin, Geneva, Switzerland, 585,602. Filed November 30, 1896.
Consists of a bow-shaped sliding contact automatically reversible on a change of direction of the car.

Switches, Cut-Outs, Etc.

RHEOSTAT AND CIRCUIT CONTROLLER. H. W. Leonard, East Orange, N. J., 585,444. Filed November 24, 1896.
Comprises an electroresponsive device connected across the circuit and arranged to hold the circuit controller in its closed position and means for opening the circuit of the device to effect the release of the circuit controller.

CIRCUIT BREAKER FOR ELECTRIC WIRES. A. J. Clark, Lexington, K., 585,507. Filed November 21, 1896.
Comprises vertical levers, each having a contact plate extended from its lower end and at right angles to the levers, and a block of insulating material to which the upper ends of the levers are pivoted.

CIRCUIT CONTROLLER FOR ELECTRIC MOTORS. H. H. Cutler, Chicago, Ill., 585,511. Filed January 8, 1897.
Combined motor starter and automatic circuit breaker.

CIRCUIT CONTROLLER FOR ELECTRIC MOTORS. H. H. Cutler, Chicago, Ill., 585,512. Filed January 8, 1897.
Similar to above.

Telegraphs:—

TELAUTOGRAPH. L. O. McPherson, Highland Park, Ill., 585,319. Filed November 24, 1896.
Employs a governor operating to change the strength of current

on line to compensate the effects of changes in frequency of the pulsations.

Telephones:—

ELECTRIC TELEPHONE. C. F. Dunderdale, Chicago, Ill., 585,560. Filed January 7, 1895.
Comprises a gravity switch consisting of a chamber divided into two compartments, located in the interior end of the receiver, a movable ball contact maker normally resting within one compartment of the chamber when the receiver is not in use, and completing the circuit in the other chamber when the receiver is shifted.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 6, 1897.

Alarms and Signals:—

RAILWAY SIGNALING SYSTEM. H. Bezer, New Rochelle, N. Y., 585,733. Filed April 22, 1895.
Means whereby the dispatching signal cannot go to "safety" until the detaining signal has gone to "danger" and the detaining signal cannot go to "safety" until the dispatching signal has gone to "danger."

Batteries Primary:—

REVERSIBLE PRIMARY BATTERY. L. W. Pullen, Camden, N. J., 585,699. Filed Oct. 23, 1896.
Comprises a cathode, a depolarizing mass in contact therewith and consisting of a mixture of finely divided carbon, a salt of manganese and concentrated sulfuric acid uniformly distributed throughout the mixture and an anode arranged in a dilute electrolyte.

GALVANIC BATTERY. J. Sully, New York, 585,854. Filed Oct. 27, 1896.
Composed of a negative, porous, gas-coke, carbon, cylindrical containing vessel, and a positive zinc pencil immersed in an electrolytic fluid of carbonate of potash and kerosene oil, contained within the carbon vessel, and resting in a small quantity of quicksilver contained within an insulation in the bottom of the vessel.

GALVANIC BATTERY. J. Sully, New York, 585,855. Filed Feb. 16, 1897.
Similar to above.

Batteries Secondary:—

SECONDARY BATTERY. I. Samuels, New York, 585,853. Filed Aug. 11, 1896.
An element, comprising a plate of active material, a terminal embedded therein, and a telescopic case of conducting material, inclosing the terminal, the case being connected to or forming a part of the terminal.

ELECTRIC STORAGE OR SECONDARY BATTERY. F. King, London, England, 586,044. Filed Jan. 26, 1897.
An element consisting of a plate having perforations therethrough containing active material, and having applied to its sides an adherent coating of india-rubber, perforations being made through the rubber and through the active material, so that the electrolyte may have access to the active material through the perforation.

Conductors, Conduits and Insulators:—

JOINT OR SPLICE FOR ELECTRIC WIRES OR CABLES AND METHOD OF MAKING SAME. F. Schwedtmann, St. Louis, Mo., 585,707. Filed Dec. 14, 1896.
Consists in forming hooks in the ends of the wire, interlocking the hooks, and then molding a conducting metal around them.

ARMORED ELECTRICAL CONDUIT. E. T. Greenfield, Brooklyn, N. Y., 585,863. Filed Oct. 7, 1896.
Consists of an external metallic armor and an internal tube of insulating material which is impervious to moisture.

ARMORED ELECTRICAL CONDUIT. E. T. Greenfield, New York, 585,864. Filed Dec. 10, 1896.
A conduit tube composed of a metal armor and an interior lining of oilcloth with the painted surface thereof adhering to the inner wall of the armor.

Dynamos and Motors:—

BRUSH HOLDER. H. Geisenhöner, Schenectady, N. Y., 585,746. Filed Nov. 20, 1896.
Comprises a rotatable stud, one or more brush holders adapted to be rotated on and adjustably held in fixed position on the stud, and means for adjustably holding in fixed position the stud.

ELECTRIC MOTOR FOR ELEVATOR. J. H. Ihlder, Yonkers, N. Y., 585,760. Filed Aug. 11, 1896.
Consists of a motor in which the current through the armature is reversed, a series field in sections, one section of which is reversed with the reversing of the armature.

BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES. R. Lundell, Brooklyn, N. Y., 585,872. Filed July 11, 1896.
Employs a stationary guideway for the brush and a movable part adapted to bear against the brush in two directions.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. J. J. Walsh, Paris, Texas, 585,726. Filed July 29, 1896.
Comprises a pair of escapement wheels arranged on one shaft, the teeth of one wheel alternating with those of the other, and pendulum governed escapement dogs alternately coacting with the escapement wheels, the dogs being mounted to swing independently one of the other.

MANUFACTURE OF INCANDESCENT LAMPS. J. W. T. Olan, New York, 586,055. Filed March 13, 1893.
Consists in introducing alkali metal into the lamp and exhausting and sealing the lamp while alkali metal is still contained therein.

Measurements:—

ELECTRICITY METER. A. W. Staveley, I. H. Parsons and T. J. Murday, Leicester, England, 585,892. Filed Jan. 5, 1897.
Recording apparatus for ammeters.

Miscellaneous:—

ELECTRICAL ATT[illegible] MUSICAL INSTRUMENTS. W. B. Fleming, Detroit, Mich., 585,663. Filed Jan. 13, 1897.
Method of operating electrical pianos comprising a roller, a conductor in electrical connection therewith, a shaft provided with a series of discs adjacent to the roller, insulated one from the other, and spring contact arms in electrical connection with the discs.

APPARATUS FOR ELECTROLYTICAL DECOMPOSITION OF SALT SOLUTIONS. C. Kellner, Vienna, Austria-Hungary, 585,959. Filed Feb. 24, 1896.
Comprises a vessel containing a solution of common salt, one or more groups of electrodes rigidly connected together by non-conducting connections, and suitable electric conductors for the first and last of the series of plate electrodes.

Railways and Appliances:—

RAILWAY DANGER SIGNALING. J. K. Kendrick, Germantown, Cal., 585,676. Filed Nov. 2, 1896.
Employs a pilot car carrying a cow catcher adapted to sound an alarm in the locomotive cab when anything comes in contact with the pilot car cow catcher.

ELECTROMAGNETIC AND MECHANICAL BRAKE. J. E. Parker, Bayonne, N. J., 585,973. Filed Dec. 17, 1895.
Details of construction.

Regulation:—

ELECTRIC CONTROLLER. A. F. Macdonald, Schenectady, N. Y., 585,772. Filed Jan. 5, 1897.
Comprises a single set of moving contacts, two sets of brushes mounted for dissimultaneous engagement therewith, the two sets of brushes establishing different circuit combinations of the dynamo electric machines, and means for changing the relation between the contacts and sets of brushes.

Switches, Cut-Outs, Etc.:—

AUTOMATIC CUT-OUT. C. N. Black, New Haven, Conn., 585,904. Filed March 15, 1897.
Combines with a dynamo electric machine having two or more independent armature circuits, two or more independent lamp circuits connected in series with and between the independent armature circuits of the machine, and automatic cut-outs corresponding in number to the independent lamp circuits which they are placed across and each providing a non-inductive path and operating to short circuit the respective lamp circuits when the voltage therein exceeds a predetermined limit.

ELECTRIC SWITCH. F. D. Hall, Syracuse, N. Y., 586,029. Filed March 8, 1897.
Details of construction.

ELECTRIC SWITCH. E. Oxley, Washington, D. C., 586,075. Filed April 23, 1897.
An automatic switch for systems of distribution in which a balance must be preserved between the sides of the systems.

Telephones:—

TELEGRAPH SWITCH. J. S. Allen, Halsey, Neb., 585,731. Filed July 25, 1896.
Comprises an instrument cut-out of non-fusible properties and a lightning arrester.

Telephones:-

SWITCHBOARD FOR CENTRAL TELEPHONE STATIONS. C. E. Egan, Chicago, Ill., 585,662. Filed Dec. 2, 1895.
Comprises flexible arms having sockets mounted thereon and contact points on each side included in the circuit of the signaling apparatus.

TELEPHONE TRANSMITTER. E. C. Wilcox and B. L. Lawton, Meriden, Conn., 585,896. Filed Aug. 31, 1896.
Employs a carbon conducting diaphragm interposed between the body and cap, and an annular elastic conducting washer bowed flatwise to produce a plurality of contact points, and arranged between the body and the cap so as to make a plurality of engagements with the diaphragm.

OPERATOR'S SWITCH FOR TELEPHONE EXCHANGES. L. Johnston, La Crosse, Wis., 585,915. Filed March 13, 1897.
Provides means to change the respective telephonic circuits through the medium of a single circuit changing cam which controls all of the contacts.

NEWS AND NOTES

JUBILEE ILLUMINATIONS IN LONDON.

Great use was made of electricity for illumination purposes in England the night of the Jubilee. The biggest piece of work was that of concentrating the beams of seventy searchlights on the dome of St. Paul's Cathedral. This performance, which produced wonderfully fine results, cost $6,000.

THE LATEST POWER PROJECT FOR NIAGARA.

Work was begun July 9 on the Canadian Power Company's power canal. The plans for the work were approved by Hon. Andrew G. Blair, Minister of Railways and Canals for the Dominion of Canada, and the work commenced is on section A of the canal, near the village of Chippawa. Surveys for the entire canal are nearly completed, and as soon as done work will be prosecuted all along the line. The canal will extend from Chippawa Creek to the head of Cedar Island. A. C. Denison, of Philadelphia, Pa., and Banker R. Paine, of Niagara Falls, Ont., represent the power company. The contractor in charge is Charles H. Morse, of Niagara Falls, South, and the engineer is Walter McCulloch, of this city. The waterway will be 15 feet deep, coming out on the bluffs near the head of the Dufferin Islands, not far from the Horseshoe Fall, into which the water will return at the level of the upper river. It is said that 40,000 h. p. can be developed, and that from 5,000 to 10,000 h. p of direct power will be used without the intervention of electricity.

TRADE NOTES & NOVELTIES

APPARATUS WANTED.

The Wicomico Falls Milling and Electric Company, Salisbury, Md., R. M. and W. T. Johnson, proprietors, are in the market for two 45 or 60 k. w. slow speed multipolar machines, or will be satisfied with Edison dynamos if in good condition. They add: "We take your paper and like it very much."

KEYSTONE ELECTRIC CO.

Mr. F. B. Downing, vice-president of the Keystone Electric Company, of Erie, Pa., informs us that the concern have been working twenty-four hours a day, and that during the past six months they have had more men in their employ than at any other previous time since their organization. Orders have been filled recently from all parts of the country, and many are in hand from abroad, countries as far away as Austria ordering apparatus. The orders range over a wide variety of apparatus, including small motors for machine tools for direct connection, required by the Union Iron Works, of San Francisco, to large railway generators of 200 horse-power for an Eastern trolley road; also a large number of special reversible motors with controllers for direct connected electric elevators.

RIDGWAY DYNAMO AND ENGINE CO.

Mr. Cyrus Robinson, general manager of the Ridgway, Pa., Dynamo and Engine Company, makers of the McEwen engine and the Thompson-Ryan dynamo, has just returned from quite an extensive trip through the East and West and has found the prospects of business unusually bright. Below is a list of sales for the end of June: One tandem compound engine, for Purdue University; one 150 kilowatt plant, for Northwestern Mining and Exchange Company; two 75 kilowatt D. C. plants, for the University of Michigan; two 50 kilowatt generators, for the City of Buffalo, N. Y.; two 75 kilowatt generators D. C. to tandem compound engines, for Tulane Hotel, Nashville, Tenn.; one 10 kilowatt plant, for W. H. Brown & Son, Pittsburg, Pa.

The order for the plant to go in the University of Michigan is particularly interesting. The plant is to be connected up on the Arnold system, so that either generator can be run by either engine. There were no fewer than 23 firms figuring on this plant, and Mr. Robinson and his company feel therefore a very excusable pride in having captured the entire contract.

EIGHTY MILE TRANSMISSION IN SOUTHERN CALIFORNIA.

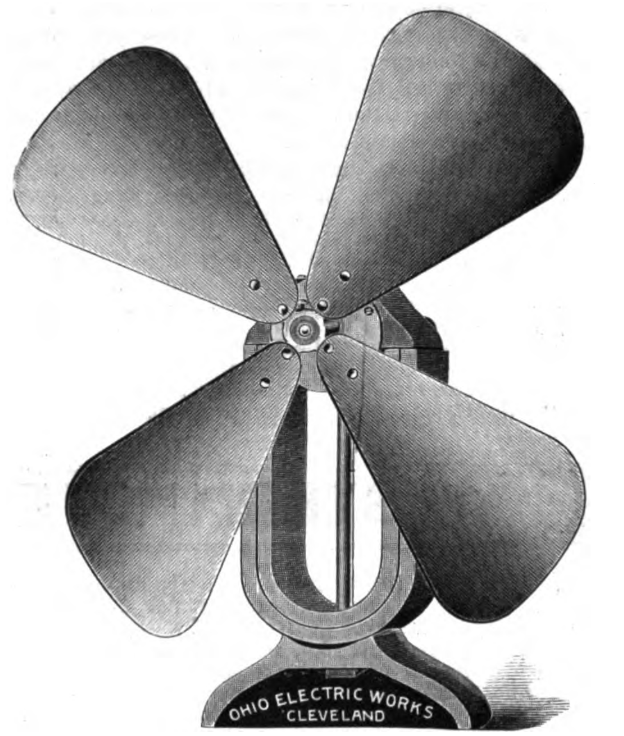
A CONTRACT for the transmission of power of the river running through the Santa Ana Canyon to Los Angeles and Pasadena, a distance of eighty miles, has been concluded between the Southern California Power Company and the General Electric Company. The amount of power to be transmitted at first is four thousand horse-power. The station will be located in the Santa Ana Canyon, twelve miles from Redlands and about eighty miles from the towns in which the electric power will be utilized. The water will be taken from the river through canal, flume and tunnel along the side of the canyon. Here it will be led into a pipe line 2,200 feet long, giving what will be equivalent to a vertical fall in the water of 750 feet.

The wheels will be of the impact type, directly connected to the generators, of which there will be four, each of 750 kilowatt (1,000 horse-power) capacity. The maximum line potential will be 33,000 volts, to which potential the initial voltage will be raised by twelve 250 kilowatt step-up transformers.

This transmission is the longest commercial electrical power transmission as yet undertaken, as well as that using the highest voltage. At present the longest is that transmitting the power of the waters of the Ogden Canyon in Utah to Salt Lake City, a distance of 36 miles. The Los Angeles transmission will be over twice that distance, and three times the longest distance yet tried with the power of Niagara, which to date has only been transmitted commercially to Buffalo, a distance of 26 miles, although at the time of the New York Electrical Exhibition it ran a small Tesla motor there, the distance being about 465 miles.

THE OHIO ELECTRIC WORKS FAN OUTFIT.

THE Ohio Electrical Works, of 813 South Water street, Cleveland, Ohio, the well known manufacturers of electric bicycle lamps and other electrical novelties, have placed on the market a decided novelty in the shape of the battery fan motor outfit illustrated in the accompanying engraving.



Ohio Electric Works Fan Motor.

In order to economize in battery power the field is created by a pair of permanent magnets fixed to the base, with the armature at the upper ends. The fan has 10-inch blades. Several hundred of these fans were sold last season and a greatly increased demand is confidently looked for this season. The company also furnish batteries for running the outfit.

THE CATARACT CONSTRUCTION CO.

At a meeting of the Cataract Construction Company directors, held in their office in the Mills Building, New York, the following officers were re-elected: President, Edward D. Adams; first vice-president, Francis Lynde Stetson; second vice-president, Edward A. Wickes; secretary and treasurer, William B. Rankine.

At the same time the directors of the Niagara Junction Railway and the Niagara Development Company held meetings and elected as their officers the officials of the Cataract Construction Company.

DIRIGO TELEPHONE CO. OF MAINE.

The stockholders of the Dirigo Telephone Company, of Maine, met at the office of J. J. Linscott, Farrington, on June 24, to act upon four special articles, namely: 1. To see if the corporation will reduce its outstanding capital stock from $500,000 to $100,000, in order to provide for an issue of preferred stock to obtain working capital. 2. To see if the corporation will authorize an issue of $50,000 of preferred stock at par, to fix the rate of maximum dividend thereon, to determine how the net earnings shall be divided between the preferred stock and the common stock and to fix the right of each class of stock in case of a future sale of all or part of the assets of the corporation. 3. To see if the corporation will authorize the directors to extend the business of the company and to establish and purchase new lines. 4. To elect a secretary to fill a vacancy in said office of secretary.

The meeting decided to adopt an aggressive policy while on the articles definite action will be taken at the annual meeting in July, when the new officers will be chosen, influential men having consented to accept office.

UNDERGROUND TELEPHONE CABLE WORK IN ST. LOUIS.

The first large underground work in St. Louis is now under way, and the Standard Underground Cable Company has recently secured from the Bell Telephone Company, of Missouri, and the Kinloch Telephone Company (both of St. Louis) two of the largest contracts ever let in this country (and probably in the world) for telephone cables; these two orders comprising all the underground cables in St. Louis yet contracted for, and constituting the complete cable equipment for both telephone companies. Both contracts were secured in the face of the most severe competition.

To fill these contracts there will be required more than 650,000 feet of cable, which, in turn, requires about 100,000,000 feet of No. 19 B. & S. G. copper wire, and 2,000,000 pounds of lead. To meet this extraordinary demand, the manufacturing facilities of the Standard Company in the paper-covering department, have recently been doubled.

Considerably more than one-half of this cable will be installed by the Standard Co., they having contracted to turn the cable system of the Kinloch Company over to that company complete and ready for service. A large force of expert workmen will be employed for nearly a year in this work, under the direct supervision of the St. Louis office.

WESTERN NOTES

MR. EDWARD C. BROOKS has been appointed manager of the Chicago office of the American Circular Loom Company, of Boston, Mass., in place of Mr. A. D. Chandler, who is no longer with the company. Mr. Brooks is a brother of Mr. H. H. Brooks, manager of the head office of the concern in Boston, who is also very well known in the West where he made a host of friends while staying there some time ago.

THE REPLOGLE GOVERNOR WORKS, of Akron, O., are now building a full line of water wheel governors purely mechanical in their operation, but retaining the extreme sensitiveness of their well known electrical water wheel governor.

INTERNATIONAL ELECTRICAL PURIFYING COMPANY has been formed at St. Louis, Mo., with a capital stock of $10,000, fully paid up, to erect electric plants to purify water. D. Reynolds, W. H. Niebling, E. H. Johnson and L. E. Walther are directors.

THE HIGHLAND ELECTRIC SOLDERING PASTE is meeting with very great favor as a soldering flux. It is put up in very convenient form for use, and certainly makes a very successful joint. The Electric Appliance Company, of Chicago, who handle this soldering paste in the West, are sending out small sample boxes. They state that the samples they have distributed have already resulted in the sale of several hundred pounds of the soldering paste, and that every customer is highly pleased with the work they can do with this flux.

ADVERTISERS' HINTS

THE ARMORITE INTERIOR CONDUIT COMPANY, Pittsburg, Pa., illustrate the new Girard office building, Philadelphia, in which 200,000 feet of "Armorite" interior conduit was laid.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., cite another instance where the result confirms their theory on the utilization of waste steam in central stations.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., advertise the "Reliance" iron box bell as the best of all.

THE LYNN INCANDESCENT LAMP COMPANY, Lynn, Mass., continue to supply renewed incandescent lamps at 12 cents and state that the results obtained by their use justify their claims of long life, efficiency and cheapness.

A. L. McRAE, consulting electrical engineer, 306 Oriel Building, St. Louis, Mo., will be glad to correspond with parties desiring estimates, plans, specifications, examinations, reports, tests, etc.

A. & J. M. ANDERSON MANUFACTURING COMPANY, 289-293 A street, South Boston, Mass., advertise lightning arresters, quick break switches and switchboards.

NEW YORK NOTES.

BEACON LAMP COMPANY, New Brunswick, N. J., have sent out a handsome 32 page catalogue of their incandescent lamps, Crookes tubes, lamp bases, etc.; also a revised price sheet of their standard copper tipped fuse links. The Beacon lamps are made with mechanical pumps, and in no case do they use mercury. They invite special attention to their series, miniature and multiple lamps.

LONG ISLAND, N. Y. Nathan C. Jessup has given his consent for the proposed trolley from Riverhead, L. I., to pass through his valuable lands, also across his now famous bridge to the ocean, cutting his fields of unripe grain so as to cause no delay. This gives the trolley company a direct route to the ocean.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXIV. JULY 22, 1897. No. 481.

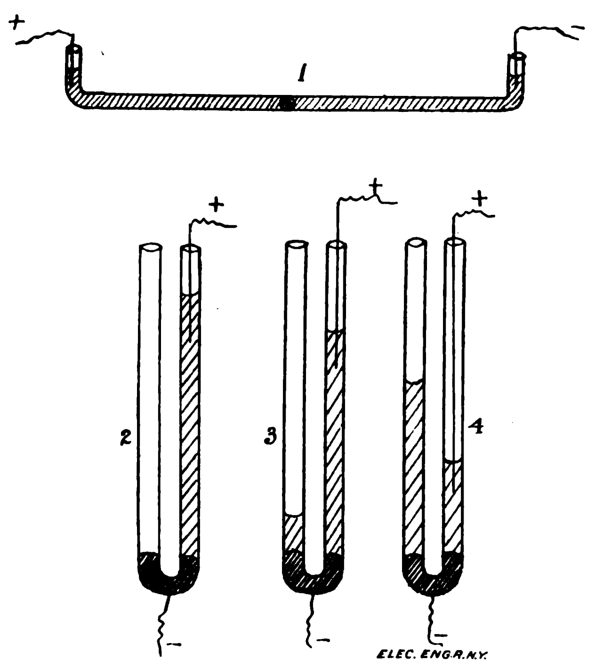
MISCELLANEOUS

A NEW EXPERIMENT IN ELECTRO CAPILLARY PHENOMENA.

BY JOSEPH W. HARRIS.

IN the well known electro-capillary experiments a drop of dilute acid is usually placed in a horizontal tube having ends bent up, and remainder of tube on each side of drop filled with mercury, or, sometimes the tube is filled with dilute acid and a globule of mercury placed in center of tube (see Fig. 1). A current passed between terminals of the latter causes the globule of mercury to move towards the negative electrode. The movement is usually ascribed to formation of gases by electro-decomposition.

In the following experiment which, I believe, has not before been published, a glass U-tube with a platinum terminal sealed in at the bend, has sufficient mercury poured in to seal off both limbs, and in one limb is poured a not too strong solution of a salt. I used solution of ammonium chloride and potassium sulphate. A current passed through the liquid with



FIGS. 1, 2, 3 AND 4.

the mercury negative (see Fig. 2) causes decomposition of liquid and forms an amalgam of ammonium or potassium, according to the salt used, and this amalgam, during passage of the current, permits the transmission of the liquid from one tube to the other, as shown in Fig. 3. That the transmission of the liquid is not due to hydrostatic pressure but to electric action can be seen by continuing the experiment for some time, when the liquid will rise to a higher level in the former empty tube than it is in the right hand tube, as seen in Fig. 4. The mercury also increases in bulk and absorbs considerable heat.

During the passage of the current the mercury acquires a frosty appearance, and one can almost see the minute drops of liquid moving through it. The solution before experiment had a neutral reaction to litmus paper, but after the experiment the solution in the limb submitted to electrolysis had an acid reaction, and the transferred liquid an alkaline reaction. The odor of peroxide of nitrogen can be readily detected among the gases given off during decomposition. On breaking the current the ammonium amalgam is decomposed by the acid liquid in the right limb, and a stream of gas bubbles is given off, the mercury reducing in volume to its former amount.

Potassium sulphate does not give such good results as ammonium chloride.

STORAGE BATTERY ENGINEERING PRACTICE.—XVIII.

BY JOSEPH APPLETON.

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STORAGE BATTERIES IN CENTRAL STATIONS—(Continued).

THERE is one application of storage batteries in connection with direct current central stations which differs from any of the foregoing. It is the outcome of the numerous efforts to straighten out the load curve, and utilize the generating plant during the hours of light load. This system will undoubtedly become a very important feature of modern central station practice when its advantages are fully recognized, as it solves two different problems, viz., equalizing the load on the generating plant by relieving it of a portion of the peak, and providing additional load during the hours of minimum load; also preventing the installation of private generating plants in opposition to central station supply.

There are many buildings, chiefly office buildings and stores of a certain class, which have a great number of lamps installed, but only use them for a few hours a day, and that at a time when the maximum load occurs at the central station. These customers are not profitable to the electric light companies, for they take current at the time when it is most valuable and nevertheless expect the lowest rates on account of the large number of lamps used; yet there is the possibility of this large number of lamps being suddenly thrown on the system in the case of a thunderstorm, etc. In addition to this, these buildings are now using electric elevators which are a disturbing element on any central station system and have to be accepted with certain limitations; but with this application of storage batteries these objectionable features are removed.

The conditions under which central stations are compelled to accept customers of this class, often force the latter to install their own generating plants, which means a loss of business to the electric light companies, while with this system they can furnish current at a cheaper rate than to the ordinary consumer and yet find it a most profitable business. If a storage battery is installed in a building of this description it entirely alters the conditions. The battery can be charged from the central station when additional load is wanted, and will furnish current for the building during the hours of maximum load, or, in other words, turns an unprofitable customer into a most desirable one. Besides this, the central station has the advantage of these batteries being connected to its system at various points, thereby equalizing the pressure over the entire system.

One of the large electric light companies in this country, which was the first to adopt this system, states that current is worth to them, to sell, during the hours of maximum load three to four times the amount at any other time of the day, and that by this system they can generate current at the cheapest time and sell it at the time of maximum value at a price profitable to both themselves and the customer; moreover, every battery of this description installed relieves their distributing system of just so much load at the time of demand, and enables them to keep a more regular pressure over the whole of the system. They also believe that this system will entirely prevent the installation of private plants in their territory.

From the consumers' point of view the matter is equally satisfactory; the cost of the battery is much less than that of a complete installation, while the attention required is practically nil. The net cost to the consumer of the light supplied under this system is considerably less than if he generated the current with his own plant or took it from the central station on the most favorable terms. The service obtained under this system is very reliable, the current obtained from the storage battery being independent of any abnormal conditions which may be forced upon the central station at times of maximum load, tending to make the supply irregular.

As previously stated, the storage battery is not liable to sudden failure or breakdown, as is the case with moving machinery where the supply of current may be interrupted instantly. In the event of overwork or neglect the storage bat-

tery will deteriorate more quickly than under proper conditions, but will not fail absolutely without ample warning.

One point which commends this system to consumers in comparison with a private generating plant is the economy in space. A generating plant requires space which is valuable for other purposes, and cannot be relegated to portions of the building which are easily spared; the question of safety, vibration, light and ventilation, etc., being of paramount importance. On the other hand, a storage battery can be located in any space, where there is ample room, ventilation being the only important point to be considered, and this is much more easily carried out than with a complete generating plant.

The method of operation under this system differs somewhat with the local conditions, but generally speaking it is as follows: The battery is charged during the hours of minimum demand on the central station, the necessary increase in voltage being obtained by means of a booster installed with the battery. While the battery is being charged the consumer's circuit is connected directly to the central station system so as to avoid any complications in regard to regulation of pressure while the battery voltage is rising as the charge progresses.

In one case, with which the writer is familiar, the booster is not needed, the charging of the battery being accomplished by means of a pair of feeders which run directly to a junction box outside the consumer's building, and are so arranged that during the hours of light load they can be disconnected from the system and used as special charging feeders for the battery.

In this case the pair of feeders is connected at the station end to the high voltage charging bus used for charging the battery installed in the station, the charging of the consumer's battery being also regulated from the station. In several cases where this system is employed the central station undertakes the entire care and maintenance of the consumer's battery; in fact they place the meter between the battery and the building circuit, thus charging only for the current actually consumed, and not for that used for charging the battery; in other words, the electric light company is willing to stand the loss in the battery, simply charging the customer for the actual amount of current consumed.

It is the firm opinion of the writer, that this system will be used to a very large extent, now that the reliability of the storage battery is established in this country. It enables the electric light companies to compete with large private installations without adding to their maximum load and raises the load factor of their stations considerably. From the consumer's point of view it means an absolutely reliable service at a moderate cost without trouble or risk and occupation of space otherwise valuable.

A METHOD OF DETERMINING MAGNETIC HYSTERESIS LOSS IN STRAIGHT IRON STRIPS.[1]

BY DR. J. A. FLEMING.

THE author's process is based upon the use of the bifilar reflecting wattmeter. The samples of iron, large or small, in the form of straight strips, are inserted in a long solenoid. The solenoid is traversed by an alternating current, and the square roots of the mean square values of the current are determined by a Kelvin balance. A flat bobbin of fine wire may be slided along the strip; an electrostatic voltmeter connected to the ends of this exploring coil gives the square roots of the mean square values of the electromotive force in that coil. From these measurements and the known dimensions of the solenoid and coil, the induction density, B, can be found at any point of the length of the strip. From these results a curve is drawn, co-ordinating the values of B to corresponding distances along the half-length of the strip. Assuming the hysteresis loss per cycle, per cc. of iron, to vary as the 1.6th power of the maximum induction density, and then raising all the B ordinates to the 1.6th power, and plotting a new curve over the first, another curve is obtained which represents the variation of hysteresis loss per cc. of iron from point to point along the half-length of strip. Now, at some point along the half-length of strip there must be a section where the induction density is B_1, such that the true mean hysteresis loss for the whole bar is proportional to $B_1^{1.6}$. Let this value of the induction density be called the "effective value," and the corresponding point in the strip the "effective point." Let $M \,.\, B^{1.6}$ stand for the mean ordinate of the curve representing the varying values of $B^{1.6}$ all along the half-length. Then, evidently, $B_1 = \sqrt[1.6]{M.B^{1.6}}$.

The following curious expermental result is found: Whatever may be the length or section of the iron strip, the point at which the actual induction density has a value equal to the "effective" value always comes at the same proportional distance from the center of the strip. This distance is very exactly equal to 0.56 of the half-length, as measured from the middle; or 0.22 of the whole length from one end. If, therefore, the secondary coil is placed at that spot, and the secondary voltage then observed is used to calculate the induction density, the value so obtained corresponds to the true mean value of the varying hysteresis loss per cc. all along the strip.

Mr. Carter asked whether roots other than the 1.6th gave a similar constant value of the induction intensity.

Dr. Fleming said it seemed to be the result of accident that the 1.6th root gave a constant value for iron.

[1]Abstract of paper read before the Physical Society.

FREQUENCY TRANSFORMATION.[1]

BY LIEUT. F. JARVIS PATTEN.

AT times we would like a comparatively high frequency for one use and another relatively low one for another on the same circuit, but at present we cannot have both from the same generator; thus compelling a sort of compromise in the selection of the frequency that a system of distribution shall be given, and this necessarily to the disadvantage of some part thereof. For power distribution, we should prefer a comparatively low frequency for motors rather below sixty than above, but so low a rate is not the best for lighting; hence, the compromise, if both are to be operated from the same circuits.

Probably the chief reason why frequency transformation has not been more seriously considered is because no really good or simple solution of the problem has yet been presented; all thus far published being burdened with a complexity of commutating devices, rings and revolving brushes that render such systems altogether objectionable. I think I was the first to show a system of frequency transformation, in a paper before the American Institute of Electrical Engineers, in 1891.

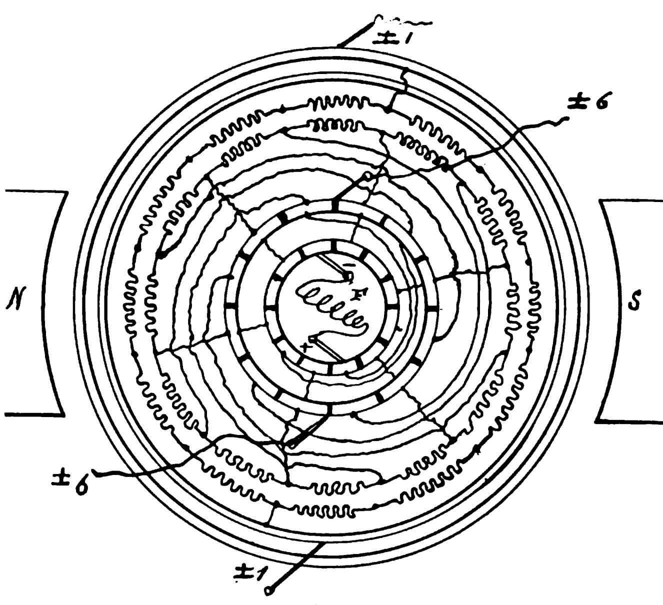

FIG. 1.

The essential features of that system are shown in Fig. 1. Briefly, a Gramme armature has a primary winding so connected to its commutator that it will turn through a certain arc, say, one-sixth of a revolution for each cycle of the alternating current, while a secondary winding of the same ring has two diametrically opposite points, connected each to a ring collector. The system by which the primary winding is connected to its commutator makes such a motor self-starting with a single phase supply, and a second commutator, reversely connected to the first at alternate segments gives a direct current for the field excitation. This apparatus will transform a single-phase alternating current of a given frequency to either single or multiphase alternating currents of one-sixth the given irequency. I need hardly say, however, that, simple as this may seem on paper, the two commutators

[1]Read before the N. E. L. A., Niagara Falls. Abstract.

render the device unacceptable to American practice, and no machine with even a single commutator or revolving brush can be regarded as a solution of this apparently difficult problem.

A frequency transformer should be a self-contained apparatus, in which all the parts are electrically or magnetically interdependent, the function of which is to induce in a secondary circuit an electromotive force of different periodicity

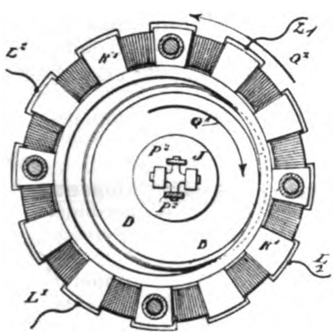

FIG. 3.

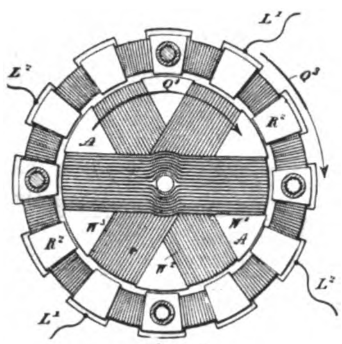

FIG. 4.

from that of the primary or inducing circuit and source of supply. Inasmuch as frequency is always the result of a relative motion of one part of a generating apparatus with respect to another, thus setting up a corresponding rate of change of induction, so it may be presumed true that changing the frequency of alternating currents implies changing the relative motion of inducing and induced parts with respect to each other, from which it may be further inferred that a moving part is indispensable.

In the apparatus I shall now describe, I obtain this change in the rate of induction by a novel form of electromagnetic motor, which is an independent part of the transformer system, and which, in conjunction with the currents of altered frequency, determines the degree of transformation. A brief description of this motor is necessary to a clear understanding of the apparatus. It is shown in vertical elevation in the lower half of Fig. 2, and in horizontal projection in Fig. 3. Its field consists of a toothed iron ring with a Gramme winding, supplied with multiphase currents through the leads L^1 L^2, setting up a rotating magnetic field in the ring. The armature is a solid iron disc, D, Figs. 2 and 3, about the same

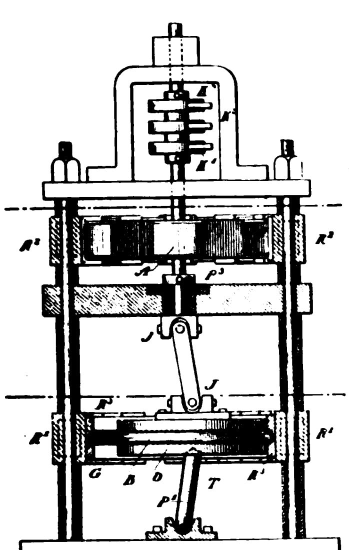

FIG. 2.

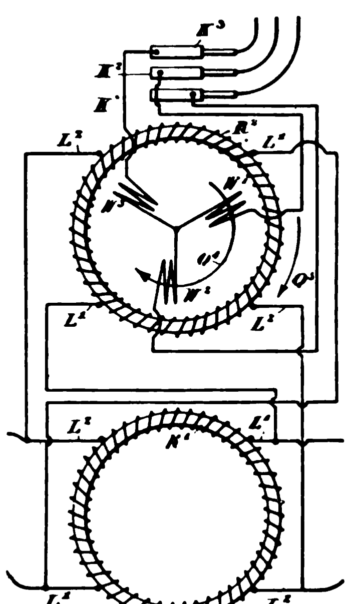

FIG. 5.

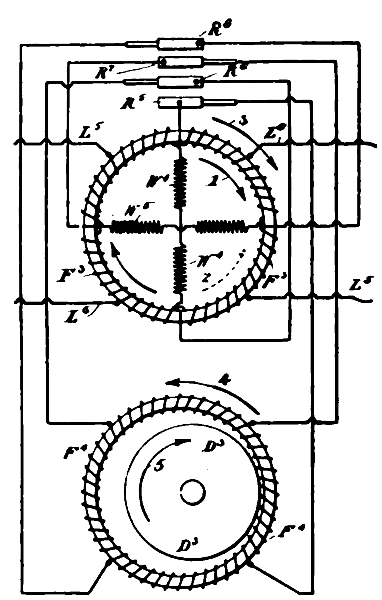

FIG. 6.

thickness as the ring, but having a diameter considerably less. It has a raised rib or flange, B, which fits into and travels in a track set in the ring, Fig. 3. This disc armature is pivoted, as shown, eccentrically to the field ring, with which it remains always in contact at one side of the inner periphery of the latter, and is supported by a spindle, P^1, which maintains the disc in stable equilibrium in any position it may assume within the ring. When the ring is energized, the magnetism attracts the iron disc, and, while holding it in firm contact against the ring at the side, it causes it at the same time to roll around the inside wall of the ring, following as it must the revolving polar line of the field. If, however, the rotating magnetism turns contra-clockwise, the disc in rolling the same way will revolve in a clockwise direction about its own axis, as indicated by the arrows in Fig. 3. Such is the motor part.

A universal joint, J, Fig. 2, serves the purpose of rectifying the eccentric movement of the disc, so that any apparatus carried by the upper spindle, P^3, will revolve concentrically with the upper ring, P^2, and this ring with its winding constitutes the primary or inducing element of the transformer, the three-coil armature, Figs. 2 and 4, with its three free ends connected to its three collector rings, Fig. 2, being the secondary element or induced circuit.

Such is the apparatus in its entirety, and it may be properly styled a motor transformer for voltage, phase and frequency, as all three functions can be performed as well simultaneously as one or two of them.

The essential peculiarity of the motor that adapts it to this use is the following: As the armature disc, D, has a smaller diameter than the ring inside which it rolls, so in rolling around the ring from a given starting point back to the same point again, the disc will have an entirely independent rate of rotation about its own axis, very different from that of the rotating magnetic field in which it turns, and which will be a function of the difference between the diameters of the disc and ring.

Here, then, we have the essential requirement of a frequency changing apparatus, the operation of which will be somewhat as follows: Fig. 5, being a diagram of circuits for reducing frequency. Biphase currents from the source of supply are introduced to the upper or transformer ring winding, the leads being so connected as to set up a clockwise rotating magnetic field in this ring. Naturally, the transformer armature would rotate in the same direction (if its circuits were closed) synchronously with the field, if free and unconstrained. If, however, the armature is not free, but is constrained to revolve at a slower rate, then multiphase currents (biphase in this instance) will be generated in its coils, having a frequency determined by the number of times the armature turns through the rotating magnetic field while the latter is making one revolution in space.

Let such constrained motion be assumed and consequent generation in the armature coils of multiphase currents, and let these currents be taken from the collecting rings and brushes thereon through leads down to the lower ring winding or motor field, the leads being so connected to this winding as to set up a contra-clockwise rotating field, or one opposite in direction to that of the transformer field above. This done, and the biphase currents from the source turned on, the motor disc will commence rolling around its ring in a contra-clockwise direction, but turning at the same time about its own axis in a clockwise direction, carrying the transformer armature with it in the direction of its own revolving field, as it would turn if free and unconstrained by the motor disc, but at a rate or speed of rotation identical with that of the

disc about its own axis, which is much slower than the speed of rotation of the transformer field—the latter having a rate corresponding to the frequency of the biphase currents supplied to it.

We, therefore, have in this transformer system a rotating magnetic field of comparatively high speed in the primary ring winding, and an enclosed secondary circuit revolving within the latter at a comparatively low speed in the same direction. Under these conditions the induced secondary currents of the armature will have a frequency due to the difference of these two rates of rotation. One of them, that of the field, is given, and the other is axial rotation of the disc—necessarily something less than that of its own motor field (when its diameter is more than half the diameter of the latter), and the latter identical with the frequency of transformed or induced currents in the armature coils. The disc acts as a sort of brake or load on the armature, holding its speed down below the synchronous rate, thus producing a slowly revolving motor field for the disc to roll in.

To increase frequency, a system of circuits like that shown in Fig. 6, will be found preferable. In this case, the biphase currents from the source of supply are introduced to both the transformer field and motor windings, and the connections are such that the transformer armature and disc will turn in a direction opposite to that of the field in which the armature revolves. In this case, as a matter of course, the induced secondary currents will have a frequency due to the sum of the two motions instead of their difference as before.

By having a variety of interchangeable motor discs of different diameters, a great variety of transformations can be made with the same machine.

TEST OF MAGNETIC CIRCUIT BREAKERS.—II.

BY C. M. CLARK AND C. W. MACMULLEN.

(Concluded.)

To make the tests on the circuit breakers, the resistance of the water barrel was adjusted so that only a certain overload of current could possibly flow in the circuit, even though the circuit breaker failed to open. The amount of the current was read by the ammeter. The switch A, was now opened, and the circuit breaker set. The revolving discs were brought up to the proper speed, and the revolutions counted. At the completion of the counting, the switch A, was closed, and the deflection of the galvanometer noted, the motor being then stopped. The radius of the circular arc made on the paper, was found, and its chord was carefully measured. This arc represents the time between the closing of the switch A, and the opening of the circuit by means of the circuit breaker. The apparatus and circuits were then examined and set again, and the experiment repeated. As is shown in the tables, three sets of five readings each, were taken with each setting of the instrument; the first with an overload not exceeding 50 per cent., the second with an overload not exceeding 75 per cent., and the third with as complete a short circuit as could be obtained, the greatest possible rise of the current, which was about two hundred amperes, being limited by the resistance of the wires and instruments.

Knowing the radius and the chord of the arc and the revolutions of the disc, the time was easily determined. Calibrations of the galvanometer were made from time to time, to see if the constants of its circuit had changed.

Setting, 15 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to .... 22.61 amperes.
Time factor .... .1183 seconds.

Setting, 15 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 28.13 amperes.
Time factor.................... .0918 seconds.

Setting, 15 amperes. Current adjusted to short circuit.
Current rose to................ 70.32 amperes.
Time factor.................... .0737 seconds.

Setting, 20 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to................ 29.08 amperes.
Time factor.................... .1199 seconds.

Setting, 20 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 30.48 amperes.
Time factor.................... .1000 seconds.

Setting, 20 amperes. Current adjusted to short circuit.
Current rose to................ 74.83 amperes.
Time factor.................... .0413 seconds.

Setting, 25 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to................ 34.02 amperes.
Time factor.................... .0882 seconds.

Setting, 25 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 41.56 amperes.
Time factor.................... .0599 seconds.

Setting, 25 amperes. Current adjusted to short circuit.
Current rose to................ 84.26 amperes.
Time factor.................... .0465 seconds.

Setting, 30 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to................ 45.65 amperes.[1]
Time factor.................... .0876 seconds.

Setting, 30 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 45.73 amperes.
Time factor.................... .0918 seconds.[2]

Setting, 30 amperes. Current adjusted to short circuit.
Current rose to................ 81.57 amperes.
Time factor.................... .0621 seconds.

Setting, 35 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to................ 50.74 amperes.
Time factor.................... .0898 seconds.

Setting, 35 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 57.91 amperes.
Time factor.................... .0708 seconds.

Setting, 35 amperes. Current adjusted to short circuit.
Current rose to................ 71.31 amperes.
Time factor.................... .0446 seconds.

Setting, 40 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to................ 58.09 amperes.
Time factor.................... .0592 seconds.

Setting, 40 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 62.35 amperes.
Time factor.................... .0588 seconds.

Setting, 40 amperes. Current adjusted to short circuit.
Current rose to................ 71.77 amperes.
Time factor.................... .0455 seconds.

The mercury contact circuit breaker differs from the carbon contact circuit breaker in the following respects. It is of the "double pole" type, breaking both sides of the circuit. Instead of the knife contact arrangement used in the carbon contact circuit breaker four projecting metal lugs on the switch arm, two lugs at each end, descend into cups containing mercury. The insulation of the lugs is so arranged that when the circuit breaker is closed, continuity of the circuit is secured, and when the circuit breaker is opened, both sides of the circuit are broken. The switch arm is so balanced that the spring used in opening the other type of circuit breaker is dispensed with, the opening of the switch arm being aided by gravity.

MERCURY CONTACT CIRCUIT BREAKER.

Setting, 4 amperes. Current adjustment not exceeding 50 per cent. overload. Range, 4 amperes to 12 amperes.
Current rose to................ 4.3191 amperes.
Time factor.................... .1668 seconds.

Setting, 4 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 6.6754 amperes.
Time factor.................... .0760 seconds.

Setting, 4 amperes. Current adjusted to short circuit.
Current rose to................ 48.41 amperes.
Time factor.................... .0475 seconds.

Setting, 5 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to................ 5.9546 amperes.
Time factor.................... .4023 seconds.

Setting, 5 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 7.8376 amperes.
Time factor.................... .1598 seconds.

Setting, 5 amperes. Current adjusted to short circuit.
Current rose to................ 59.67 amperes.
Time factor.................... .0812 seconds.

1. In this particular test the current rose slightly above 50 per cent. over load: which was due to a slight change in the E. M. F. of the dynamo, and also that the circuit breaker was somewhat sluggish in its action. All the tests were made under most practical conditions; following as nearly as possible the ordinary circumstances under which circuit-breakers are operated.

2. It will be noticed that at the setting of 75 per cent. over load the time was between three to four thousands of a second greater, this was due to a drop in voltage; resulting from heavy load on dynamo, causing the current to build up at a slower rate.

Setting, 6 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to................ 6.6675 amperes.
Time factor.................... .3878 seconds.

Setting, 6 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 8.1943 amperes.
Time factor.................... .1969 seconds.

Setting, 6 amperes. Current adjusted to short circuit.
Current rose to................ 59.74 amperes.
Time factor.................... .0574 seconds.

Setting, 8 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to................ 11.5111 amperes.
Time factor.................... .2733 seconds.

Setting, 8 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 12.15 amperes.
Time factor.................... .1368 seconds.

Setting, 8 amperes. Current adjusted to short circuit.
Current rose to .... 66.69 amperes.
Time factor.................... .0718 seconds.

Setting, 10 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to................ 66.69 amperes.
Time factor.................... .2883 seconds.

Setting, 10 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 14.76 amperes.
Time factor.................... .1891 seconds.

Setting, 10 amperes. Current adjusted to short circuit.
Current rose to................ 61.28 amperes.
Time factor.................... .0747 seconds.

Setting, 12 amperes. Current adjustment not exceeding 50 per cent. overload.
Current rose to................ 16.66 amperes.
Time factor.................... .3051 seconds.

Setting, 12 amperes. Current adjustment not exceeding 75 per cent. overload.
Current rose to................ 19.41 amperes.
Time factor.................... .2452 seconds.

Setting, 12 amperes. Current adjusted to short circuit.
Current rose to................ 62.27 amperes.
Time factor.................... .0548 seconds.

A comparison of the two forms of circuit breaker tested, i. e., the carbon-contact, and the mercury-contact circuit breakers, brings out some points of interest. The carbon-contact circuit breaker would seem to be better for general use. There is no troublesome arcing when the circuit is broken, and the moving parts are simple and effective. With proper care, the danger of corrosion is very slight, provided this type is used where there is not much dampness.

These circuit breakers have quite a high resistance, the one with a range of from 4 to 12 amperes having a resistance of .28 ohm (approx.), while the one having a range of from 15 to 40 amperes has a resistance of 0.5 ohm. Hence, the first consumes 2.52 volts and 22.68 watts, and the second 1.5 volts and 4.5 watts at working current, assuming these currents to be 9 and 30 amperes, respectively, or three-quarters of the maximum.

The mercury contact circuit breaker, in its present form, has the objection that it throws off mercury when operating. This kind of circuit breaker, is, by a slight jar, very apt to raise the contact points just out of the mercury, forming an arc and giving off very objectionable gases, besides spattering the mercury about. A slight jar may even throw them entirely out of contact, as they depend, to a greater or less extent, on gravity, to operate them. At the beginning, of the action, the inertia of the movable parts opposes the effort due to gravity. As the center of gravity changes, the motion is accelerated, but before this acceleration becomes appreciably large, objectionable arcing takes place.

In the operation of circuit breakers, for each setting, it would seem that the average current multiplied by the time would always equal a constant. This would be true if the operation of the circuit breaker depended only on magnetic action, but since in the majority of instruments, the solenoid serves only to release a spring which in its turn throws the switch arm and breaks the circuit, it follows that certain mechanical quantities must be introduced into the equation; and these quantities are not constants. In fact it is proper to divide the time required for a circuit breaker to open, into two parts, one being the time required for the current to supply the necessary electromagnetic energy and the other being the time of action of the mechanical elements of the apparatus. From the results obtained, it was found that the circuit breakers did follow, approximately, the law stated above.

LIQUID AIR AS A FACTOR IN ELECTRICAL DEVELOPMENT.

IN a communication appearing in the Boston "Herald," Prof. Elihu Thomson dwells upon some interesting considerations regarding liquid air as a possible factor in electrical development as follows:

The well known effect of cooling by liquid air or like gases, a conducting metal like copper, is to almost abolish its resistance. Consequently a conductor so cooled is able to carry very much larger currents with less loss than at ordinary temperatures. This fact has attracted the notice of electricians and physicists for a long time past. It has recently been found that liquid air is one of the most perfect insulators, and that most insulating materials cooled to the temperature of liquid air are greatly improved in insulating qualities. It is known, also, that cooling renders it more difficult to cause a spark to occur between oppositely electrified conductors, the striking distance for a given pressure being diminished.

The stability or permanence of liquid air in bulk, even when it is fully open to the ordinary atmosphere or kept at atmospheric pressures, is, of course, simply dependent upon the heat insulator provided, and if this could be made perfect the air would never evaporate.

Recent methods, such as those of Hampson and Linde, make it possible to obtain large supplies of liquid air by simple means and with moderate expenditure of power. Niagara power is 24-hour power, and as there are but few industries demanding power for the whole day it must follow that surplus power is either not used or wasted, and that to keep the plant working night and day at full capacity is desirable even if some of the power only yields a moderate return. Can it not be used in making liquid air? Cannot the excess at certain times of day be put to use in compressing air to be afterward liquefied on the large scale?

It would seem that large tanks of liquid air can be heat insulated very perfectly by layers of air and fibrous material properly placed outside. The evaporated air from the tank could traverse the jacketings in successive order from within outward so as to help keep down the temperature of the jacketings. A furnace with an internal temperature of 2,000 degrees to 3,000 degrees above the normal temperature of the air is easily insulated by moderate thicknesses of asbestos or other fibrous coatings so that the outside temperature is but slightly above the normal.

The temperature difference between liquid air and normal air is, say, ⅛ of that between the interior of the furnace assumed and the normal, so that it ought to be possible to insulate so that but little heat would enter. In most electric long distance transmission lines, a loss on the line of about 10 per cent. to 15 per cent. is suffered. With 10,000 horse-power this would mean from 1,000 to 1,500 horse-power lost in resistance of line. If the conductors were immersed in a pipe with liquid air the loss might fall to not over 1 to 2 per cent. perhaps, leaving available a range power for condensing air to supply evaporation.

Just how far 1,000 horse-power would go in keeping the conductors supplied with liquid air coatings is a matter requiring data to determine. But if it were not sufficient for the purpose there is the surplus of power during certain hours to supplement it.

But it may be possible that a much higher voltage than is now used (10,000 to 20,000 volts) may be successfully used with conductors cooled and insulated by liquid air. If the potential could be raised to 50,000 volts, either the loss on the conductors for a given power transmitted would fall off as the inverse square of the voltage, as the conductors could be made smaller in the same proportion or the distance of transmission increased with the same section of conductors as the square of the potential.

These are matters worthy of experimental determination. The limit to the capacity of an electric transformer to transfer energy from its primary to its secondary circuit is found in the heating and loss involved in the copper conductors comprising these circuits, and upon the nearness with which the two circuits may be placed one to the other, which is in turn governed by the insulating material used to separate them. Could the conductors be kept cool by liquid air, and thereby their conductivity and insulation greatly increased, the work of transfer in a transformer could be much greater for a given size than it now is, or the loss could be made even less than it now is, although but 3 per cent. is sacrificed in ordinary practice.

Transformers in liquid air might be made entirely of copper

without iron, and their light load efficiency become nearly equal to full load efficiency. A transformer without iron would avoid the loss in the air, and would permit such a saving in material that changes in design or disposition of the copper could be made to suit the condition of absence of the iron.

We need not touch upon the possibilities of liquid air as a means of energy storage, for they are self-evident enough, since liquid air is virtually compressed air, which remains compressed, as it were, even when exposed to atmospheric pressure; that is, addition of heat gives to it pressure and the ability to do work in suitable engines as in the usual compressed air motors. Our object has been to briefly point out what may be termed possibilities in electric engineering, assuming that data favorable to the ideas presented be the outcome of experimentation.

It is too early to make any predictions or calculations concerning this subject. It must be confessed that it has a certain fascination. Perfection of heat insulation seems to be the key to the situation. All else seems to depend on that, the main questions being what will it cost in power and machinery to supply the necessary evaporation waste in a system of the kind outlined, and whether the voltage of transmission can be raised in consequence of the new conditions.

LUMINOUS RADIATIONS FROM THE HUMAN BODY.

At the Société de Biologie, at Paris, Dr. Luys read a paper describing experiments made by him, showing the presence of luminous emanations which surround the human body, and he demonstrated it in the following manner. In the dark room, place your fingers for about 20 minutes on an ordinary photographic plate which is itself in a bath containing the usual solution of hydro-quinone, and after this exposure fix the negative in the usual way. You will see not only your fingers and the lines on the skin reproduced, but also their pores, and, what is still more interesting, round the fingers a sort of zone or halo a third of an inch wide, which would lead one to believe that we live in a luminous fluid, which has enabled us to obtain a photographic print of itself and of the fingers, as if under the influence of light. Dr. Luys has tried the same experiment, but without any results, on patients whose hands were paralysed, benumbed, or insensible to touch. No image appeared on the plate.

ELECTRIC LIGHTING

THE SHOREDITCH, ENG., REFUSE DESTRUCTOR AND ELECTRIC WORKS.

TOWARD the end of last month the Vestry of Shoreditch, London, celebrated the completion of its electric light and refuse destructor plant, the switching on of the current being done by Lord Kelvin.

The Buildings.—The buildings consist of a destructor house and engine house, as well as suitable offices for the new department. The engine house is 68 feet long and 46 feet broad, and is shown in Figs. 1 and 2. It is arranged with the high-tension continuous current steam dynamos on one side, and the low-tension sets and station motor transformers on the other side. A gallery of ample width is provided against one wall of the engine house to accommodate the three switchboards. Adjoining the engine room is the test room, in which will be erected all the testing instruments, and which, in addition, will be used for the calibration of meters. The offices, which front on to the street at the end of the engine room, contain suitable accommodation for the Electric Lighting Committee to hold their meetings, for the engineers and for ordinary office purposes. In order to prevent, as far as possible, vibration from the running of the engines, the whole floor of the engine house has been made a solid mass of concrete, about 10 feet in thickness, and the surface of this has been tiled over in a neat manner. The destructor house is a building 80 feet by 80 feet, with a roof of unusual shape and dimensions. It forms a portion of the covering for the sides of the buildings in place of carrying the brick walls right up to the usual heights. (See Fig. 3.) There are also provided bathrooms, both for the engineers and the men, and accommodation for the men for taking their meals, etc.

Refuse Destructors and Boilers.—The refuse destructors and the steam raising plant are so interconnected in this installation that it is impossible to describe the one without

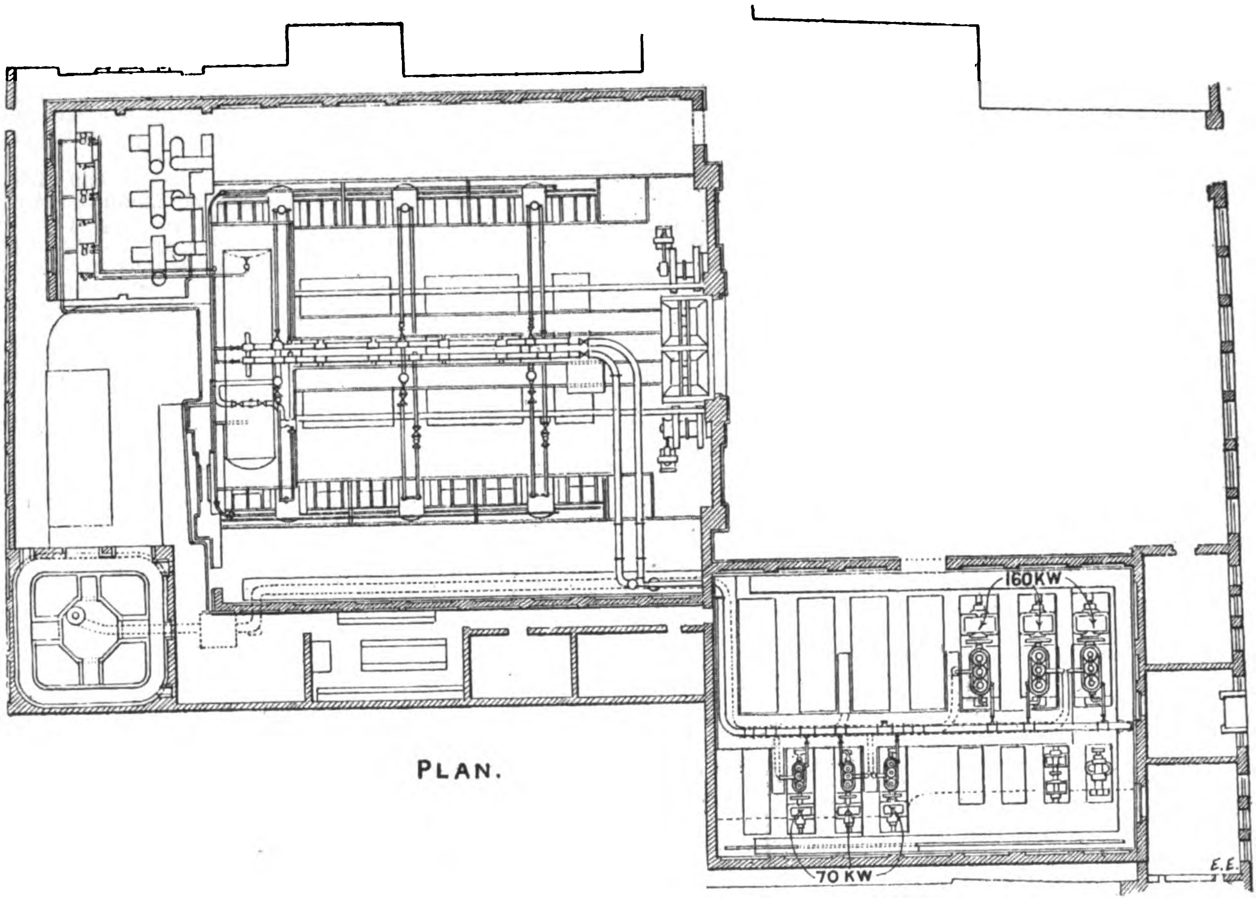

Fig. 1.—Shoreditch, England, Electricity Works and Refuse Destructor.—Plan.

the other. This part of the work was executed by Messrs. Manlove, Alliot & Co., who in 1893 reported to the Vestry as to what results they could guarantee in the way of heat for electric lighting purposes by the burning of 20,000 tons of dust per annum. This firm reported that with the aid of the thermal storage system of Mr. Druitt Halpin such refuse would produce sufficient heat for the electric lighting station proposed by Mr. Manville, the consulting engineer, and they pointed out that the value of the steam so produced would be £4,290 per annum, and that a saving of at least £1,500 would be effected by burning the dust instead of disposing of it by barging.

The destructor house contains 12 cells for burning refuse, and 6 Babcock boilers, which are placed each between two destructor cells. The chimney is 150 feet high and 7 feet internal diameter at the top. It is lined with firebrick throughout. At the base a centrifugal dust-separating chamber has been constructed. The cap of the shaft is of cast iron put together in segments. The cells are worked under forced draught supplied from the fans placed in the adjoining shed. These fans are driven by motors on the fan axis, and are each capable of delivering 8,000 cubic feet of air per minute against a pressure in the ashpits equivalent to 3 inches of water. Steam jets are also provided to increase the draught should occasion require.

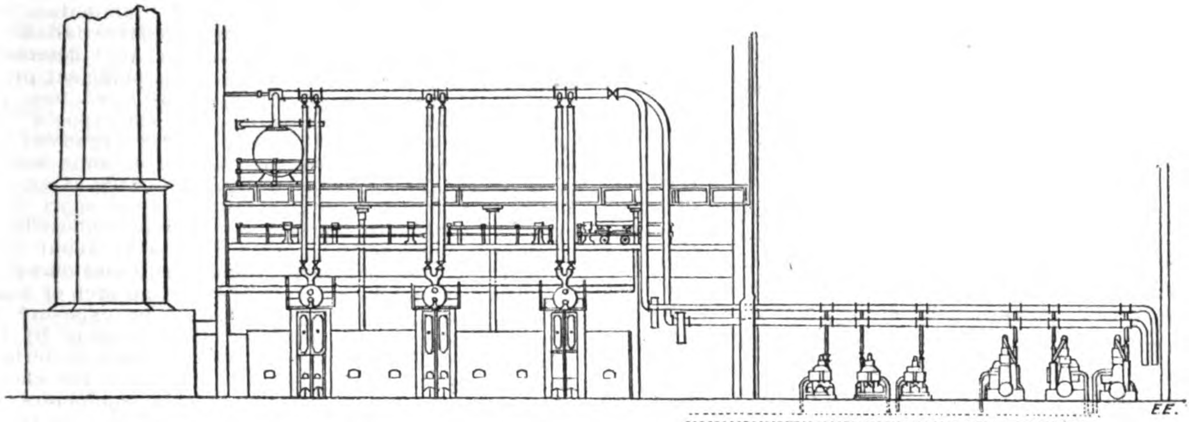

FIG. 2.—SHOREDITCH, ENGLAND, ELECTRICITY WORKS AND REFUSE DESTRUCTOR.—LONGITUDINAL ELEVATION.

The gases pass from the destructor cell directly to the space above the fire bars of the boiler. The openings in the firebrick seating are near the front, so that the hottest part of the cell delivers direct into the boiler. Also, as the green refuse is higher up on the sloping grate, any noxious fumes distilled off by the temperature rising are drawn down over the hottest part of the fire and cremated. Wherever required, each boiler may be shut off entirely, by means of dampers, from each or both of its adjacent cells. It may also be fired at all times with coal or any other suitable fuel, or independently at times of heavy load, as the ordinary fire bars are provided under the boiler. Again, the cells may be worked independently of the boilers, but in this latter contingency the gases pass out from the cells at the back and not at the front. Owing to this arrangement, the cells may be repaired independently of the boilers, and the boilers may be repaired independently of the cells; moreover, in the event of refuse not being collected or being deficient from any cause whatsoever, steam may still be raised by means of coal in the same manner as is adopted in any other electric lighting boiler house.

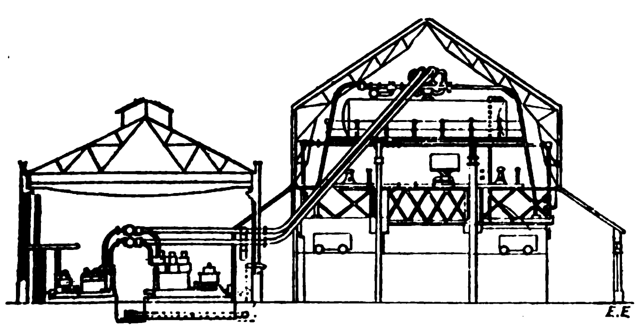

FIG. 3.

The cells have each a grate area of 25 square feet, and the boilers have each 1,300 square feet of heating surface. The flues are arranged in duplicate to facilitate cleaning, as one flue can keep the whole station going.

The cells themselves are not charged with refuse by hand, but by means of Boulnois and Brodie's patent charging trucks. This arrangement is novel as arranged at Shoreditch, although the principle has been adopted in many other district stations. This arrangement and the gear for handling the refuse are worthy of special note. At one end of the destructor house two electric elevators have been erected to hoist the refuse to the tipping platform. The dust carts discharge their loads into large hoppers, mounted on electric bogies, which are placed on the elevators. When the hopper is full, it is elevated to the level of the tipping platform. There two electrical connections are made to two trolleys running on overhead wires. On the circuit being closed the motor on the bogie moves the hopper along the rails, until it has reached the required position. If the refuse is required for immediate use, it is shot outward by tipping the hopper as the two rows of openings on each side of the central bins discharge direct into the charging trucks. The central row of openings lead to the storage bins, where a certain amount of refuse can be kept till wanted. That this is a necessary provision will be understood when it is remembered that the dust carts collect during the day time only, while the destructor will cremate the refuse at a regular rate throughout the twenty-four hours. The two electric lifts are worked by one motor, which is geared to the hoisting drum by means of a worm and wheel running in oil.

The remaining feature of the destructor scheme is the use of Mr. Druitt Halpin's thermal storage system. At present one cylinder, 35 feet long and 8 feet diameter, has been installed, and is supported on the girders, shown in Fig. 3. Steam will be generated in the boiler at all hours, owing to the necessity of burning refuse continuously, and hence the working conditions are essentially different from those prevailing in the ordinary coal-fired boiler house. On the other hand, light being required on a large scale only during some four to six hours out of the twenty-four, it is obvious that without some system of heat storage a vast amount of valuable steam would be wasted. With the arrangements at Shoreditch, during the day time, steam generated in the boilers will be passed into a thermal storage cylinder, where it will be mixed with a small quantity of cold water from the feed pumps, the proportions being such that when the evening approaches, the cylinder will be full of water at the temperature and pressure of the steam required by the engines. The cylinder will then be shut off from the feed pumps and connected to the boilers, which in their turn are connected direct to the engines; hence, when the boilers require feed water, they are supplied with it from the cylinder at such a temperature that the fuel that is then being burnt has merely to furnish to the water in the boilers the heat sufficient to overcome the latent heat of evaporation at the required pressure. The result of this arrangement is that the boilers are able to evaporate about one-third more steam than they would be able to evaporate were they fed direct. The importance of the thermal storage cylinder is further enhanced by the fact that it acts as a water purifier, as in it the deposit will be thrown down instead of in the boilers. When more storage cylinders have been added, steam will also be drawn from the thermal storage, but at present it will be used as a feed storage only.

THE ELECTRICAL PLANT.—There are two systems of electrical generation and distribution used at the Shoreditch station. One of these is a low tension system of 150 to 165 volts for supplying consumers in the immediate vicinity of the

station and the other is what is known in England as the "Oxford" system, named so after the place in which it was first employed. This latter system furnishes current for the outlying districts at 1,000 to 1,1000 volts. These high tension circuits are led to substations where rotary transformers are situated which convert the current to a potential of 165 volts for general distribution. At these substations storage batteries are installed.

The system of charging adopted for current for lighting purposes is the Wright demand indicator system, 6d. per unit being charged for an average daily use for two hours of each lamp demanded through each half-year, and 4d. per unit for electricity consumed beyond that average two hours' consumption. In addition, there are two rates of charging for current used for motive power purposes—namely, 3d. per unit for current which may be demanded at all times of the day and night, and 2d. per unit for current that may be demanded during the hours of daylight.

THE INCONSISTENCY OF PLAIN IRON INTERIOR CONDUITS.

BY "JIM CROW."

IN these days of rapid progress and constant individual effort to outstrip one another in the production of novel ideas and applications, it seems advisable to pause occasionally for the purpose of reviewing what has been done in the past and considering the possible effect of new methods on practices that have heretofore been attended with success.

Some electrical engineers have apparently neglected such precautionary consideration, however, in their efforts to introduce the use of plain iron pipe as an interior electrical conduit; and while an individual may readily be excused if he is a little over zealous in the exploitation of his pet scheme, it would seem that a reasonable degree of conservatism should be expected from Departments of Inspection which make and enforce wiring rules that govern electrical workmen throughout the entire country.

For a number of years the art of electrical wiring has progressed along lines of safe construction and high insulation; and on these lines electrical men have put forth an incalculable amount of energy in creating and codifying rules which have the one word "INSULATION" as their sole foundation. These rules require, among other things, that conductors of low tension currents when placed inside of a building must be covered with rubber insulation at least 3-64th of an inch in thickness. They must be kept free from contact with gas, water, or other metallic pipes. They must be protected when passing through floors, partitions, etc., by tubes of glass, porcelain or other such material. They must be kept apart at least 2½ inches. And they must be supported wholly on incombustible insulators.

These are a few of the requirements for so-called open construction, where the conductors are surrounded by air except at the points of contact with the porcelain or glass insulators placed about 4 or 5 feet apart; while it is proposed by the advocates of plain iron conduits to place conductors connected to the same circuit in other parts of the building, side by side, in a plain iron pipe, which is grounded all along the line.

A peculiar result of this plain pipe rule and its contradictions is shown by the recently published specifications of an electrical engineer of national reputation who calmly requires that "all conductors be installed in plain iron pipe," and that "all fixtures be provided with insulating joints of the latest and most improved design," etc. Surely there is some slight inconsistency in such rulings and their results; and the average lay property owner can scarcely be blamed if he concludes that quite a large percentage of electrical rule makers and engineers are eligible candidates for a sanitarium.

There is something truly pathetic in a proposition which embodies plain iron pipe and insulating joints in one installation; and, while the first impulse is to give way to the ludicrous aspect which is presented, when the erroneous position is realized in all its enormous proportions, feelings of merriment are quickly dispelled by the most deep-seated regret for the years of labor, the incalculable amount of capital and the number of human lives that have been sacrificed in order to demonstrate the necessity of high standards of insulation, with no result other than the proposition to go back of the beginning and install conductors in plain iron pipe mainly for the purpose of reducing the cost of installation.

One of the excuses given for the use of uninsulated conduit is that combination gas and electrical fixtures have always been of uninsulated pipe and have contained many miles of electrical circuits; but most engineers will acknowledge that these electroliers have almost invariably been provided with insulating joints offering resistance of from 1,000 to 5,000 megohms, and even with this precaution about 90 per cent. of the trouble which has been experienced in conduit systems has been developed in the unlined fixture stems.

Many people object to the use of insulated iron-armored conduits, for the reason that in past years the insulating lining has not come up to their expectations, inasmuch as it has softened and cracked under high temperatures. But this can scarcely be considered as a valid excuse for rejecting entirely the use of insulated conduits, unless the man who, upon discovering an error in the indications of his meter, is to be excused for denouncing all systems of illumination other than the good old-fashioned and always reliable tallow candle.

If 3-64th of an inch of soft rubber, that deteriorates rapidly by exposure to the atmosphere, is sufficient protection to conductors laid in a grounded, uninsulated iron pipe, it is equally sufficient for conductors that are exposed their entire length. Therefore, on the same line of argument the owner of a building who purchases marble or slate switchboards, switch and cut-out bases and panel boards at an expense of $1,000 to $1,500 in a large building is little short of a lunatic, when he could just as well have his switchboards and other appliances made of cast iron frames at about 2½ cents a pound, and from which he could easily and cheaply insulate his switches and cut-outs by 3-64th of an inch of hard rubber, which would not readily deteriorate by exposure to the atmosphere and which could be made fireproof by being covered with a sheet of asbestos or other such material; and the man who bought unsightly and expensive porcelain or glass insulators on which to support his conductors would be guilty of a most reckless extravagance, for he could just as well use cheap cast iron knobs of an ornamental and attractive design, or double pointed tacks which would be still cheaper.

With the plain iron pipe rule for concealed work in force, Inspection Departments must, in order to be consistent, withdraw their requirements for the expensive high class insulation required by existing rules for open construction. But it does not seem possible that such highly intelligent men as those at the head of the Inspection Bureaus of this country can deliberately take such a long step backward; and it is doubtful if these men are willing to admit—as a plain pipe rule would imply—that they are unable or unwilling to find a satisfactory method of insulation, or that they are unable to comprehend insulation beyond that provided by 3-64th of an inch of soft rubber; nor is it probable that the manufacturers of America are unable to produce any higher insulation. There are now on the market interior insulated conduits that are practically unaffected by any degree of heat or moisture to which they can possibly be submitted in service; and such conduits can be obtained for less cost than those found on the market two years ago.

This subject was more or less aired in one of our electrical journals last spring; and, although the number of the articles printed was not large, their tenor did not indicate, as was assumed in the summing up, a "preponderance of opinion in favor of plain iron pipe," as the following figures will show: Of the whole number of letters printed nearly 42 per cent. were absolutely in favor of insulated- iron armored conduit; fully 19 per cent. were in favor of an enameled conduit, making a total of 61 per cent. in favor of an insulated conduit; while 30.5 per cent. were in favor of plain iron pipe, and the remaining 8.5 per cent. were written by three men, one of whom declined to express an opinion, another believed in plain iron pipe, but admitted that his opinion was of no value, for the reason that he had had no experience to justify his belief, while the third failed to express much of anything except a burning desire to revolutionize the present system of inspection. It would, therefore, appear that in the absence of any overwhelming demand for such a radical departure from former teachings, it might be well for Inspection Departments to consider carefully the promulgation of new rules, which, if enforced, will be, to say the least, inconsistent not only with their own requirements, but also with the common-sense rules of good, safe construction.

TARPON SPRINGS, FLA., QUITS.

At a special freeholders election at Tarpon Springs, Fla., it was voted to discontinue the lighting of the streets. The electric plant of the Tarpon Springs Electric Light and Water Company, A. P. Weller, manager, has been moved to St. Petersburg, Fla., and will be in operation August 1.

ALTERNATING ARC LAMPS IN CONNECTION WITH CONDENSERS.

In an interesting communication appearing in our esteemed contemporary, "l'Industries Electrique," M. Georges Claude puts forth a strong claim for the employment of condensers in connection with alternating arc lamps, whose unsteady action, he asserts, can be entirely obviated by the use of condensers. He bases his claims on the statement that if alternating current arc lamps act badly the cause thereof is due largely in the increase of the apparent resistance of the regulating magnet which accompanies the sucking in of the magnet core. In order that these lamps may approach to the conditions existing in continuous current lamps all that is necessary is to make arrangements for keeping this resistance constant.

It will be further apparent that the ideal conditions would be realized if we could so arrange matters that the resistance diminishes when the core is sucked in, for in that case the current would vary faster than the difference of potential, and we would thus reach even more favorable conditions than in the case of the continuous current.

In order to verify his theory M. Claude made experiments on an arrangement similar to that illustrated diagrammatically in Fig. 1, in which a condenser is shown in series with a shunt magnet around the arc. These trials show that the current varies in fact twice as fast as the difference of potential, and, again, that it varies scarcely 1-5th as fast when the shunt magnet alone is in series, without the condenser. It will be evident that under these conditions the least variation in the distances between the carbon is followed by a considerable variation in the attraction, and that therefore a lamp thus modified is in an infinitely better condition of regulation.

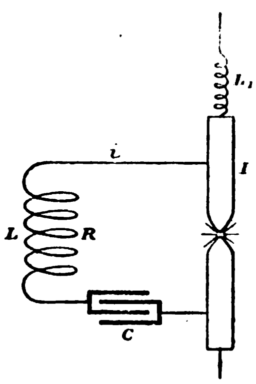

FIG. 1.—ALTERNATING ARC LAMP WITH CONDENSER.

It must be remarked, however, that suitable precautions ought to be taken to avoid a source of instability brought about by the very efficiency of the condenser. Supposing, in effect, the core to be in equilibrium in a certain condition; now if the core for any reason is sucked in a little deeper, by the very fact of this displacement it will permit of a greater current passing through the coil, and it may happen that it may continue its movement to the end of its limit. But it is evident that it would suffice to avoid this trouble to employ an antagonistic force of sufficient variable rapidity.

The condenser necessary for this work need be constructed to resist a potential of only thirty or forty volts existing at the terminal of the lamp, raised, perhaps, to fifty or sixty volts by resonance effects. Under these conditions the thickness of the dielectric in the condenser need be but very thin.

On the other hand, this arrangement will necessarily lead to very fine coils in the lamp, having high self-induction, and thus at high frequency requiring but very small capacity for their neutralization. In practice only very small condensers would be required, consisting of a disc 10 centimetres (4 inches) in diameter and a thickness of 3 centimetres (1.2 inches). Such a condenser could be easily lodged in the lamp case, and would cost very little.

CARBIDE OF CALCIUM has been found to be a remedy against the phylloxera, according to a Swiss trade journal, and to be also an excellent fertilizer for plants of all kinds.

ALTERNATE CURRENT DYNAMOS IN PARALLEL.

BY LAMAR LYNDON, Kobe, Japan.

In your issue of May 5, Mr. J. E. Woodbridge, in concluding his clear and instructive article on "Alternate Current Dynamos in Parallel," says:

"The ideal governing arrangement (and an easily attainable ideal) for a set of engines or turbines, each driving one of a multiplied set of alternators, is a single governor controlling, through connected mechanism, the point of cut-off, gate opening or gas admission, as the case might be, of all the power units. Such a mechanism would, for example, keep the cut-off in each of a group of engines at the same point. All engines of the same size in the group would then be exerting at any load the same power, and engines of different sizes would be exerting powers proportional to the sizes of their cylinders."

I wish to call attention to the fact (probably well known to Mr. Woodbridge, but overlooked by him), that while with a governor of the kind mentioned, the I. H. P. of the various engines would be strictly proportional to the areas of their respective cylinders, it does not necessarily follow that the brake or effective horse-power would be.

The assumption that there would be no acceleration or retardation of any engine in the group controlled by a single governor, actuating the cut-off of each, could only be true, if the mechanical efficiencies of these engines were equal. Now, it is a well known fact that the ratio of brake to indicated horse-power, even in identical engines, is never the same, except, perhaps, when they are first installed, and, indeed, the mechanical efficiency of the same engine varies with conditions of wear, lubrication, condition of valves and piston, and (most of all) packing.

For this reason, it is plain that engines giving indicated horse-powers proportional to their cylinder areas, will usually give brake horse-powers that are in no wise so proportional, and as it is the brake horse-power that determines the acceleration or retardation under load, the method of regulation proposed will hardly give the desired result.

As a matter of fact, instances have come under my observation in which the $\frac{\text{b. h. p.}}{\text{i. h. p.}}$ has varied as much as 8 per cent. in the same engine, and I have seen small engines actually slowed down by tight packing.

Of course, with extreme care in construction and operation, it might be possible to make the mechanical losses of each unit proportional to its cylinder area, but I doubt if this could be effected in continuous practice.

LIGHTING PLANS OF A CHICAGO IMPROVEMENT ASSOCIATION.

At a meeting held at the Wellington Hotel, Chicago, the organization of the Wabash Avenue Improvement Association was effected, comprising merchants and business men on Wabash avenue, two from each block between Lake and Harrison streets.

The objects of the Association are to originate, discuss, and put into execution all plans and projects that will contribute to the improvement of Wabash avenue for business purposes. The plan at the outset which suggested itself as being of primary importance was that of securing adequate lighting for the street at night by the installation of an average of ten arc lamps to each block between Lake and Harrison streets by private subscription. These arc lamps are to be hung out in front of the places of business at a point designated by each subscriber. The only uniformity sought to be preserved will be the distance in which the lamps are to be hung from the frontage of the buildings and the pavement. Other schemes for the improvement of the avenue have already been broached and the general prospects of the street as a business thoroughfare are much brighter than they have been for some time past. The lamps which are to be used will be the five ampere, low tension, single enclosed arc type and will be hung on a wrought iron ornamental bracket of peculiar design. A specimen arc lamp submitted by the Chicago Edison Company was on exhibition during the second meeting of the association.

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ELECTRICITY FROM GARBAGE.

ONE of the problems which confront municipalities of every size and description is the disposal of garbage. Where towns are located near the ocean or in proximity to large bodies of inland waters the usual bad practice is to load the offal on barges, tow it out several miles from land and dump it. Most of it probably goes to the bottom, but enough keeps afloat to find its way ashore, as the disgusted and nauseated bathers at Coney Island and on the New Jersey coast can vouch for. In Chicago the practice of dumping garbage into the source of the city's water supply, Lake Michigan, has given rise to such epidemics of typhoid fever that the intake for the water mains has recently been pushed out again several miles further into the lake. Where no such large bodies of water exist, the only alternative is to dump the foul mass at some presumably safe distance from the inhabited locality, filling up "flats," where it rots and festers indefinitely. As time passes and the electric railway reaches out its arms, these filled in "flats" become the building lots of the real estate speculator and the inhabitants of dwellings erected on them are constantly subject to the noxious emanations from the made ground on which they live. All this is an old story, yet no attempt worth mentioning has been made in this country to remedy this state of affairs. In strong contrast to our own supineness on this subject, and perhaps because of the greater pressure of the necessity, are the efforts making in England to solve this question in a satisfactory and at the same time economical manner. The cremation of garbage in so-called dust destructors has now been introduced in a number of English communities with apparent success, but what is more to the point, is the utilization of the heat value of this waste product for the generation of steam for driving electric light engines. The latest example of this class of installation is that erected by the Shoreditch Vestry, London, which is described and illustrated elsewhere in this issue. Perhaps the most salient feature of this installation is the employment of the Halpin thermal storage system. This leaves the work of the boilers practically independent of the load on the station and permits of a continuous disposal of the garbage.

The example before us leads us to believe that in this direction many of our own electric light and power companies may find a way to increase their profits with a comparatively small original expenditure. It may be taken for granted that any municipality would welcome a proposition that would relieve it wholly or in part of the expense of carting or dumping the city garbage several miles off; it might even be, and usually is, willing to pay something to be relieved of the trouble and expense. Even granting the low calorific value of garbage as a fuel, the abundance of the supply and the absence of cost to the company would make its use under the boiler just that much clear profit. But it seems to us that, aside from the purely economical side of the question, there is another which is well worth considering in these days of municipal ownership agitation. We may be mistaken, but we believe that an electric light company that would offer to receive and cremate or "render" all, or a part, of a city's garbage, would raise a host of friends in that community, on whom the corporate property destroyer would make little impression. Thus from several points of view it appears worth while for American electric light companies to look into the garbage fuel question, or to consider the matter of going into the garbage rendering business, where it can be done without offending the nostrils of the neighborhood. The tentative efforts made in this direction by many of our American communities attest the need of some systematic dealing with the problem, for our cities are growing rapidly, while notions of economy and of the value of refuse forbid longer resort to the barbaric methods of old.

THE COST OF STEAM POWER.

THE cost of steam power is now more than ever the subject of anxious study among power users, and electric station operators are eager for any light that can be shed on the matter. But it seems that it will take some time to reconcile the varying figures presented. One of the most remarkable statements which we have recently seen is that of Mr. Frank P. Sheldon, mill engineer of Providence, R. I., who has been investigating the question of cheap fuels in New England, and who communicates some interesting figures to the Engineering Record regarding the cost of power in New England textile mills; the figures, it is stated, being obtained from the actual accounts for a year's time, kept by the mill owners. The engines used were compound condensing with steam pressures from 125 to 130 pounds. The engines were of from 1,000 to 1,200 h. p., working against a steady load 10 hours a day for 307 days per year. Mr. Sheldon gives in the following table the highest and lowest cost per h. p. per year, among several plants examined.

	Lowest.	Highest.
Fuel	$4.76	$6.60
Labor	2.34	2.71
Supplies	.31	.51
Repairs	.19	.31
Total running expenses	$7.60	$10.13
Fixed charge	4.04	4.72
Total cost per horse-power per year	$11.64	$14.85

The fixed charges include taxes, interest at 5 per cent., insurance and depreciation at 5 per cent. The large difference, according to Mr. Sheldon, is chiefly due to the cost of fuel, which in the first or lowest plant cost $1.76 per ton of 2,240 pounds, and in the second, or highest, $3 per ton.

These are most astounding figures when compared with others which have gone on record from accepted authorities. Even Dr. C. E. Emery, who will certainly not be accused of having ulterior designs against the perpetuation of steam as a motive power, never approached the rosy figures of Mr. Sheldon. As it happens, Dr. Emery in a paper read before the American Institute of Electrical Engineers in 1893 gives the results of a very comprehensive study of this question of costs, involving conditions almost identical with those encountered by Mr. Sheldon. Thus, Dr. Emery's figure for a 500 h. p. plant running 308 days of 10 hours each per year, with coal at $2 per ton of 2,240 pounds, with compound condensing engines, is $21.97 or nearly $22 per h. p. per annum; while with coal at $3 per ton the cost was $25.53 per h. p. per annum. Making due allowances for the difference in the size of plant in the two cases the difference is still far beyond what could be explained in this way. To go more into detail, we find that where Mr. Sheldon gives as the cost of coal for the $3 per ton plant as $6.60 per annum, Mr. Emery cites $10.69. Dr. Emery allows 5 per cent. more for interest, depreciation, etc., than does Mr. Sheldon, but even this increased figure fails to account for the great gap yawning between them. The statement that steam power can be produced in New England for $11.64 per annum must sound queer to those who have established themselves at Niagara Falls. However, we do not think they need have any regrets; but for the interest and benefit of the entire industry of the country Mr. Sheldon ought to give a further detailed statement, showing how he arrived at his extraordinary results.

LAMENTATIONS FROM LAKEWOOD.

THE following pathetic little item appears in the Cleveland Press of July 12:—

"Lakewood's electric light plant was not started on July 4, as promised by the hamlet officials. As a result the citizens are up in arms. They are roundly censuring the trustees, who, they claim, are responsible. The hamlet was never darker. Its streets are lined with trees, which keep out the light from the stars and moon. An indignation meeting is being strongly advocated."

We have made a few inquiries on the subject and learn that, as suspected, this is another of the many municipal plants that have gone wrong. The hamlet of Lakewood is a suburb of the city of Cleveland, to the westward. Some time last Fall, the people authorized the issue of bonds to the extent of $20,000 for the purpose of providing a plant to furnish them with a certain number of arc lights for their streets and incandescent lighting for their houses. An agreement was made by the hamlet with a contractor to erect the plant, but last April he threw up the job. Since that time, the hamlet has been trying to get the security company that was on the contractor's bond to go ahead with the work, but that plan has not succeeded. The condition of affairs was thus graphically described in one of the local papers last May:—

"Festoons of electric wires, several rows of poles and a partially completed dynamo and power shed, constitute the present Lakewood electric light plant. The claim is made that nearly all the work will have to be done over. It is alleged that the wires are not properly attached to the poles, some of the complainants going so far as to declare that they are only wrapped around the cross-beams. When the plant was begun, it was given out that electric lights would be burning in Lakewood by the middle of April. The poles were raised in the middle of Winter. Some of them are already toppling. They are crooked and ungainly. Mayor Tyler is severely criticised for permitting such a state of affairs. No attempt, is is claimed, has been made to have the plant completed. Meanwhile, the wires are rusting on the poles."

Meantime, the hamlet is paying interest on its $20,000 of bonds, has no light, and is without prospect of getting any.

CONFIDENCE IN STREET RAILWAYS.

THE attitude of investors at the present time toward street railway enterprises must be regarded both as a sign of better times and as a proof of the confidence felt in that particular form of investment. The Metropolitan Road in this city has just offered $2,000,000 for subscription in 5 per cent. gold bonds, and the public came forward so readily to take it up that the subscriptions reached more than $50,000,000; in other words, the issue was asked for twenty-five times over. Not long ago such a mark of confidence and better feeling would have been simply impossible. We note also that the issue of the $4,000,000 of bonds, 5 per cent., at 97½, and accrued interest, of United Traction Co., of Pittsburg, were also subscribed last week more than twice over. The New York Metropolitan bonds which were offered at 105 have been selling in the open market at 110½.

The trade figures in favor of this country are certainly not the least remarkable of the conditions pointing to improvement. The exports for the fiscal year ending June 30 are the largest in the history of the country by $21,700,000, reaching a total of $1,051,987,091, and exceeding the imports for the year by the very respectable amount of $287,613,186. No man would be regarded as going rapidly to the dogs whose farming or whose bank account stood that way. Moreover, aside from our advantageous trading of the past year, there is abundant proof that this year, with wheat up about 20 cents, this country is the only one with an average crop, of which a large proportion will be required for export at advancing prices.

It is curious that at this juncture when bank reserves are generally so far above the legal ratio, and when gold seems more likely to come flowing into the country than to be leaving it, such enormous finds of the precious metal should be reported from the far Northwest, both within our own borders and the Dominion. In fact, Canada looks to us as on the verge of a gold mining boom that is likely to throw even Transvaal and Californian records into the shade. Out of these, and other conditions, there can be but one outcome, at no great distance of time, and that is, distinctly better business everywhere. Out West it has certainly begun.

THE FAILURE OF GERRYCIDE.

IT will be remembered that gerrycide, or electrocution, was introduced a few years ago, with a great flourish of trumpets, as being the best means of inflicting the death penalty and as being destined by its mysterious nature to lessen the number of murders. The New York Superintendent of State Prisons has completed the collection of statistics showing the number of executions for murder that have taken place within the State of New York since its creation as a State. The result shows a remarkable increase in the number of executions since the killing by electricity began in 1890. Since that time forty executions have taken place, while from the creation of the State until that date there were but 230 hangings, as far as the Prison Department has been able to learn from the statistics gathered from all the counties. This shows an increase of more than 200 per cent. a year, as compared with the number during the preceding 100 years.

Mr. C. N. Baker, chief clerk in the Prison Department, remarks that the increase was most surprising, and in his opinion is due to either one or both of two conditions, viz.: that juries, believing in the humanity of the present system of execution, are more liable to convict; and that, the place of execution being removed from the county where the criminal is known, there is less likelihood of successful efforts being made for executive clemency.

For our own part, we regard gerrycide as a very uncertain and very brutal means of killing anything or anybody; but whether it be humane or cruel it has at least had the effect, or is attended by the result, of a seriously abnormal increase in the number of murders. Once more we venture to move for the repeal of Mr. Gerry's law.

PROF. ALFRED M. MAYER.

IN the death of Prof. Alfred M. Mayer, American science has lost one of its brightest and noblest lights. Though perhaps less well known to the present generation than to the student of twenty years ago, his writings and lectures in his chosen fields will always stand as models of precision and clearness of expression. It was no mean tribute which Joseph Henry bestowed upon the youthful Mayer when he called him his son in science; for there have been too few, unfortunately, among American scientists who, like Henry and Mayer, have cultivated science for science's sake alone, and have stuck to their laboratories, regardless of the blandishments and allurements from without, which tempt the man of science of to-day. The charm of Prof. Mayer's personality will always remain as a tender recollection to all whose privilege it was to know him.

ROUNDABOUT BY TROLLEY.

ONE of the greatest charms of the bicycle is that it opens up to the wheeling tourist whole regions of beautiful country into which as a pedestrian he was not likely ever to have set foot. All the delights of exploration and adventure are associated with the most modern facilities of locomotion and can be enjoyed without tax of one's powers of endurance. Equally true is this of the trolley car, which is to-day emphatically the chief means of transportation for the great mass of the people. So far a-field do the trolley lines run, and so moderate are the fares, a poor man can now indulge in wide travel and experience that sense of absolute detachment from the everyday surroundings which is not the smallest benefit of a holiday. The radii of these trolley trips are best learned from such a guide book as that published recently by Miss K. M. Abbott, of Lowell, who, in a dainty but inexpensive little manual, lays out for the old Bay State no fewer than sixty sunny days of trolley trips. This book, which can be slipped in a side pocket, is full of good pictures and overflowing with information, and opens up for a tour of reminiscent discovery all the historical spots of Massachusetts in a way that was not possible before the ubiquitous trolley came. And while bicyclists are often worthily indignant at the way the trolleys cut up some of the best rural roads, they can forgive much when as an offset they get such admirable guide books from their friend, the enemy.

ELECTRIC TRANSPORTATION

THE LACHMANN CONDUIT SYSTEM OF ELECTRIC TRACTION.[1]

THE traction system devised by Herr Eduard Lachmann, of Hamburg, is of the underground conduit type, but a special device has been employed to lessen the leakage from the conductor in wet weather and when the conduit is flooded.

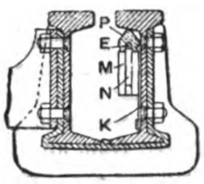


FIG. 1.

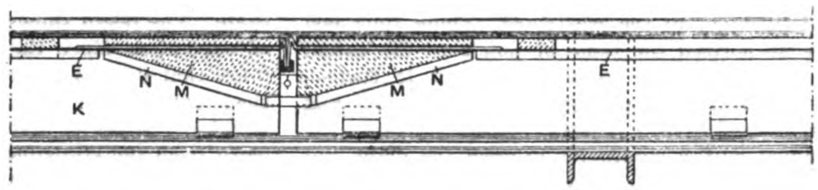


FIG. 2.

Figs. 1 and 2 show the construction of the conduit when it is arranged to take the place of one of the track rails, Fig. 3 shows the form of the collector employed, and Fig. 4 is an elevation of the truck of a car showing the three collectors. In Figs. 5 and 6 is indicated the method of applying the system to an existing track without disturbing the traffic.

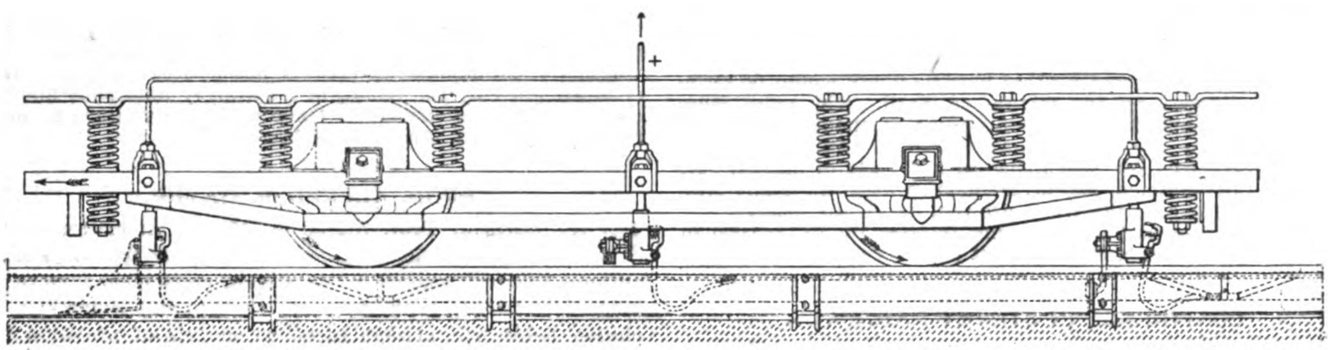


FIG. 4.

Referring to Fig. 1 it will be seen that the sheltered part of the conduit is formed by the pieces K ending in a hood P in which the conductor E runs. This part of the conduit is divided into lengths of about 8 feet, and these lengths are closed at the ends by tapering insulating pieces M, which fit airtight. This hood being closed at the ends constitutes an air-chamber which prevents the water rising as high as the conductor, even if the whole track be flooded. A groove N guides the collector at the joints; its action is clearly seen in Fig. 4.

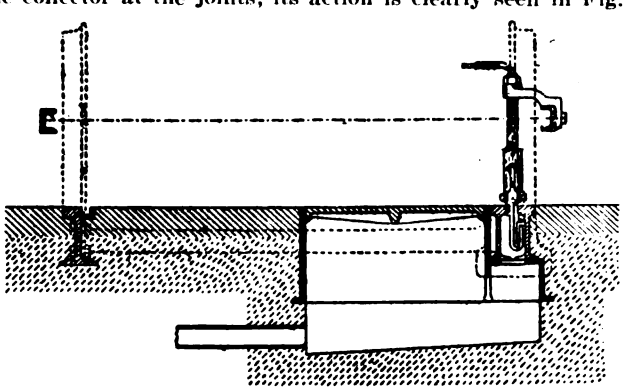
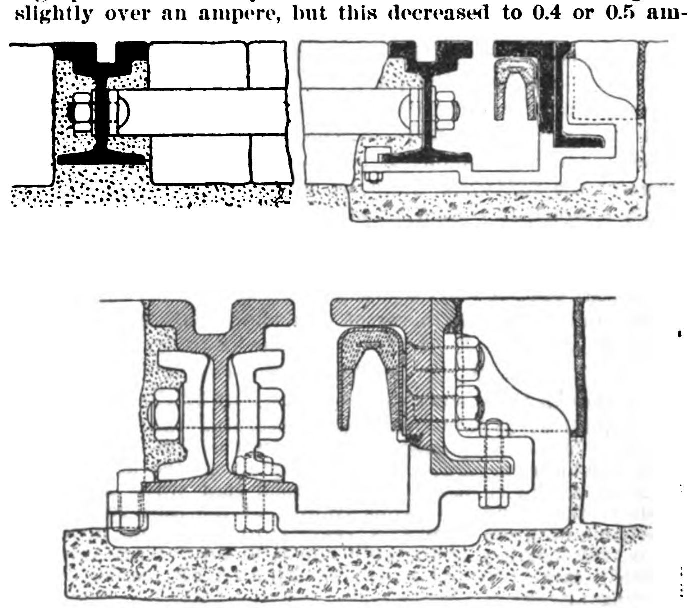


FIG. 3.

By having three collectors spaced at proper intervals, two are always in contact with the line. This also simplifies the arrangements at junctions. There is a joint in the line conductor at every joint in the hood. The conduit is drained at intervals in the usual way. Among the advantages claimed is that the depth of the conduit is only slightly over 6 inches, in fact no deeper than the rails themselves. The width of the slot can be reduced to ⅝ inch.

Tests have been made on an experimental track in Hamburg by an independent expert. The line was 175 yards long and single track; its greatest curve had a radius of about 100 feet, and the gradients (the maximum being 1 in 15) were so arranged that the whole track could be completely covered with water. The tests were made on a rainy day, and the pressure was 500 volts.

A single section was first tested, with its air-chamber filled with water. It was found that gas was evolved and that in consequence the water was forced away from the conductor and the ammeter returned to zero in a few minutes. The experiment was then repeated, using liquid mud and street filth instead of clean water, and the same results were obtained. After this the conduit was completely flooded, and it was found that the leakage current only amounted to from 0.2 to 0.3 ampere. When the car was in motion the splashing up of the water by the collector increased this leakage to slightly over an ampere, but this decreased to 0.4 or 0.5 ampere when the car reached the upper end of the track. The track tested had been laid nine months, during which time it had frequently been under water, and none of the sections had been renewed. Similar official tests had been made in October by the Hamburg government laboratory, when still better



FIGS. 5 AND 6.

[1]London Electrician.

results were obtained. A trial track 650 yards long is to be laid down in Vienna.

NEW RATING AND NOMENCLATURE OF G. E. RAILWAY MOTORS.

IN response to a letter of inquiry we have received the following details regarding the new rating and nomenclature recently adopted by the General Electric Company for their railway motors:

The company have ceased to rate railway motors by their horizontal effort or drawbar pull, because various combinations of winding and gearing in the same motor are now frequently required, and, of course, the possible horizontal effort of a given motor, say, the G. E. 800, is no longer a fixed quantity. We decided, instead, on a horse-power basis of rating for all of our standard motors, and adopted an entirely arbitrary set of numbers to designate the motors developed since the G. E. 800, 1,200 and 2,000. These last three motors have become so well known that it has been thought inadvisable to change their designating numbers.

The horse-power rating of our railway motors is that which the motors can continuously do for one hour while increasing in temperature up to 75 degs. In comparison between average service and our basis of rating, we find it advisable to furnish motors of such sizes that their average service will be from 20 to 30 per cent. of their horse-power rating. The tests for rating are made with the motor stationary and the cover open, as it has been found that this arrangement approximates the condition of actual service as regards heat radiation; it is also estimated that the temperature of the surrounding air is not more than 25 degs. C. Such a basis of rating fairly represents the conditions of ordinary service and leaves sufficient margin to meet emergencies without injuring the motor.

It should, of course, be clearly understood that the above rating is only aplicable to intermittent work, such as the propulsion of railway cars, and cannot under any circumstances be considered as the rating of the motor for work of a continuous nature.

The following data with regard to standard G. E. railway motors, give their horse-power output on the above basis:

G. E. 800, 27 h. p. at 50 amperes input; G. E. 1,000, 35 h. p. at 65 amperes input; G. E. 1,200, 38 h. p. at 78 amperes input; G. E. 51, 80 h. p. at 140 amperes input; G. E. 2,000, 135 h. p. at 230 amperes input.

DERI'S ALTERNATING-DIRECT CURRENT RAILWAY SYSTEM.

MR. MAX DERI, who is well known in connection with the Zipernowski-Deri alternating system, in Austria-Hungary, has recently brought out a method of operating electric railways by means of a combined system of alternating and continuous current, which is described in the Vienna Zeitschrift für Elektrotechnik.

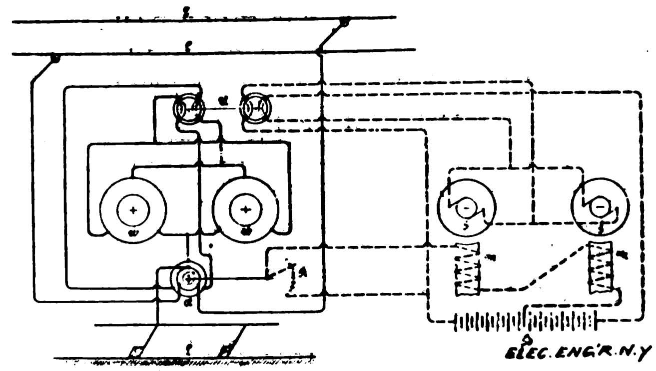
Mr. Deri's system embodies methods for taking advantage of the economy of distribution to be attained with high potential currents and at the same time the utilizing of storage batteries to equalize the load and to assist in the starting of the car from rest, etc.

Single or polyphase alternating currents are led to the line-conductor, either directly or through stationary transformers. Whether the conductor be overhead, underground or on the surface is immaterial to the system, but it should be mentioned that its continuty may be broken at any places where it is troublesome to maintain it, such as at points and crossings, within stations, etc. Connection is made with the conductor in the usual way. Each car or train is equipped with an alternating current motor and a continuous current machine that can run as dynamo or motor. The two machines may be mounted on the same axle or combined as a motor-generator, or some of the axles can be fitted with alternating and the others with continuous current motors. The alternating-current motors receive current from the line, and the continuous current machine is connected to a battery of accumulators carried by the car. The axles of the car or of the train perform, as it were, the duties of a countershafting, and the motors are thus an alternating continuous current transformer and furnish continuous current to charge the cells.

When, as on descending gradients, the power put into the alternating current motor more than suffices to drive the car, the continuous current machine runs as a dynamo and charges the cells. When ascending an incline the power required is more than the available power of the alternating motor, and the battery drives the continuous current machine as a motor. In places where the continuity of the line is broken the battery suffices to drive the car until the line is reached again. As the car can thus be started without the use of alternating current, one can use single-phase alternating current direct from the line. Although single-phase motors will not start under load, it is well known that they work perfectly on reaching a certain speed.

The great advantage of Deri's system of regulation is that the alternating current motors are working under a fairly steady load at their best efficiency, and at the same time the use of a shunt-motor connected to accumulators enables energy to be stored that would otherwise have been wasted. The cells act also as a "buffer-battery," maintaining the demand for current from the machines steady and allowing them to be worked most economically. The capacity and weight of the battery can be relatively small, however, as the chief current it has to deliver is for the starting of the cars.

The connections (with the controller omitted) are shown in the figure. They are from a project of an electric locomotive with four axles, to be worked by three-phase currents. L L L are the line conductors, W the alternating current motor, G the continuous current shunt-motor, M its field-magnets, B the battery, A the automatic regulator, R the regulating resistance, and U the switches for the two circuits. The automatic regulation of the system is apparent from the diagram.



DERI ALTERNATING DIRECT CURRENT RAILWAY SYSTEM.

Its action is to keep the strength of the alternating current between fixed limits, and at the same time the e.m.f. or opposing e.m.f. of the continuous current machine is so varied that the battery is charged or discharged according as the electrical power of the alternating current is in excess or falls short of that required by the car. In the automatic regulator devised by Mr. Deri, the alternating current passing through it to the motor tends to turn an armature against the force of a spring. The turning of this armature turns the arm of a liquid resistance rheostat and increases or decreases the resistance in the field circuit of the shunt-motor. A small change in the speed of the alternating current motor occasions a relatively large change in the current through it, and by means of the automatic regulator this current is kept constant by alteration in the excitation (and therefore the e.m.f.) of the continuous current motor, and thus increases or decreases the load on the alternating motor. In the example shown on the diagram, the exciting circuit is only connected to half the battery, so that the excitation is not affected when the battery is divided into two parallel groups for starting and braking.

During running, the speed of the continuous current machines and the strength of the continuous current is regulated in the usual way by a controller. This controller, which also acts on the shunt coils of the motor, is chiefly used in starting and stopping, and the switching on and off of the alternating current and the braking is also effected by it. Under the circumstances described the well known advantages of a shunt-motor for tramway work will have full effect. The difficulty in making use of these advantages under ordinary circumstances has been that shunt-winding for a pressure of 500 volts could not well be carried out on machines of the size usually employed. In this case, however, the e.m.f. of the battery can be made comparatively low (100—200 volts). The combination of the shunt-motor and battery make, moreover, an excellent braking arrangement, it enables a large part of the kinetic energy of the moving train to be recovered on stopping, and permits of the employment of an exceptionally high torque for starting, etc.

In the case of new tramway systems it is desirable to use a

low periodicity, so as not to cause any troublesome induction effects in telephone circuits. The worst disturbing effects, viz., those caused by the shaking of the brushes, would at all events be entirely absent. Again, the current flowing from the line to the car when it is running does not vary as much in this system of regulation as in the usual system, and the places where large variations in the current occur are at fairly wide intervals. The effect of earth currents is reduced to a very small quantity. By the use of several transformer stations the return circuit is greatly shortened, and, where it is deemed necessary, copper feeders to the return circuit are added. There are, of course, no electrolytic effects on alternating current circuits.

ELECTRIC RAILWAYS IN SOUTH AFRICA.

Henry A. Butters, of Oakland, Cal., has left for Europe on business connected with an English syndicate which has received a concession covering the entire electric street railways of Johannesburg, South Africa. The culmination of this deal throws the entire electric street railway system of South Africa into the hands of the Butters' syndicate. In this transaction several Americans now prominent in South African affairs are heavily interested. Among them are J. K. Waterman, formerly General Freight Manager of the Colorado Midland Railway of Denver; John Hays Hammond, Henry Butters and his brother, Charles Butters, who is now in Johannesburg.

TRAMPS OBJECT TO THE THIRD RAIL.

A special dispatch from New Haven, Conn., of July 7, says: Another attempt was made at a late hour last night to wreck a train load of passengers on the Consolidated Road. This time it was on the third rail of the electric section. The usual plan of piling obstructions upon the track was again carried out, and but for the careful attention of the motorman would have been successful, and a whole car load of people would have been hurled from the track. As in the other cases, the perpetrator of this dastardly deed is unknown, but there is a suspicion that it is the work of tramps who are angry over the railroad people laying the third rail, which renders walking the track dangerous for that fraternity.

ATCHISON AND ELECTRICITY.

Developments of consequence before long will be disclosed in the affairs of the Atchison, Topeka & Santa Fé. There are intimations that large operating economies are likely soon to be put into effect on the system through the adoption of electrical equipment on conspicuous branches of the great system.

LITERATURE

AUFSTELLUNG VON PROJEKTEN UND KOSTENVORANSCHLAEGEN FUER ELEKTRISCHE BELEUCHTUNGS-UND KRAFTUEBERTRAGUNGS-ANLAGEN.—(Prospectus and Estimate of Cost for Electric Lighting and Power Plants.) By Johann Riha. Leipzig; Von Veit & Co. 1897. 5 x 7½ in.; 438 pp.; 198 illustrations. Cloth. Price, $3.20.

There is no work in the English language to which we could exactly compare the book before us. In one sense the work is an anomaly, as it is practically impossible to embody in any general work information that can be directly applied to each single instance arising in practice, where one might say, every case is a special case. What the author has attempted to do is to give a brief description of the principal apparatus which the German market affords, to state what its capabilities or limitations are, and to estimate the proper cost based on what might be called units of light or power, as the case may be.

The part devoted to financial considerations, in which the author estimates the probable profits of a given installation, are well worthy of study. Particular attention has been devoted, and we think justly so, to the subject of depreciation.

Regarding the choice of systems for transmission of power, the author, after describing the various systems available, comes to the following conclusion: 1. That the three-phase system is superior to the other systems in general economy, especially if long distances have to be traversed. 2. The regulation of the three-phase current presents no obstacles. 3. The multiphase motors at the present time are cheaper in cost, more economical in operation, more convenient in handling, and give rise to less disturbances in lighting circuits than the single-phase alternating current motors. We believe that this view of the situation is well borne out by American practice. The author has added to the work a considerable number of tables of price lists of apparatus upon which costs can be estimated, and adds plans of model stations. A book of this kind, based on American practice, would prove a valuable addition to our meager literature on this subject.

TELEPHONY AND TELEGRAPHY

THE MULTIPLE TELEPHONE SWITCHBOARD LITIGATION OF THE WESTERN ELECTRIC CO., vs. THE HOME TELEPHONE CO., OF MOBILE, ALA.

LAST August the Western Electric Company brought suit against the Home Telephone Company, of Mobile, alleging the infringing of the Scribner patent, No. 330,061, of November 10, 1885, entitled "Multiple Switchboards." Testimony was taken subsequently and arguments have recently been concluded before the U. S. Circuit Court, at Mobile.

Three of the seven claims of the patent are alleged to be infringed; they are as follows: ,

Claim 2.—At a telephone exchange central office, the combination of multiple switchboards with telephone lines each permanently connected to a metallic portion of its switch upon each board, each telephone line being also connected through the contact points of its switches and to ground, and means whereby the circuit of the branch wire of any given line is opened when a connection is made with the line at any board, whereby any two lines may be connected together upon either of the boards without including in their circuits the contact points of either of their switches.

Claim 4.—The combination, with a telephone line provided at each switchboard of a multiple system with a connecting bolt or switch, of a portion of said line connected through an annunciator to ground, and means for breaking said line when a connection is made with the telephone line at either one of its bolts or switches, substantially as and for the purpose specified.

Claim 6.—In a multiple switchboard system, a telephone line provided with a spring jack at each switchboard of the system, said spring jacks being provided with insulated metallic frames, and said telephone line being connected directly to each of said insulated frames, and also through an annunciator to ground through the springs and contact points of said spring jacks, whereby a connection may be made direct to the telephone line at any board at the same time the portion of said line containing the annunciator is broken, substantially as set forth.

The accompanying engravings are reproduced from the drawings of the patent.

COMPLAINANT'S ARGUMENTS.—In the brief submitted by complainants, the history of the art is gone into at some length, the testimony of Mr. T. D. Lockwood, one of the witnesses for the complainants, being quoted at length.

As regards the scope of the claims in question, Mr. Scribner, on the witness stand, described the object of his patent to be as follows:

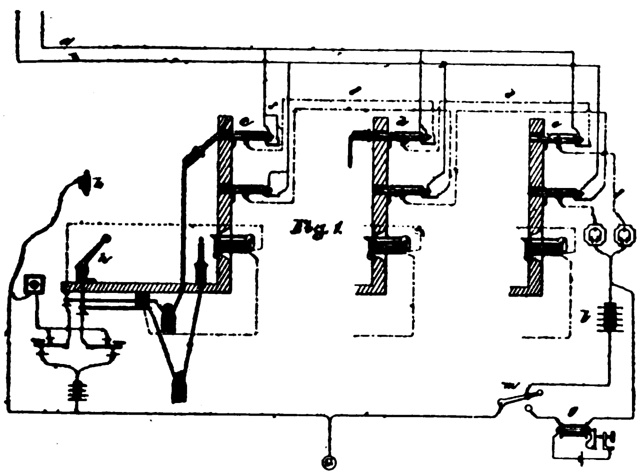
"The patent in suit, No. 330,061, is for a multiple switchboard. The result sought to be accomplished by the invention of this patent is the connection between any two subscribers' lines in a telephone exchange, the exclusion of contact points from the circuit of such connections, while, at the same time, the indicator annunciators of such connected lines are temporarily cut off from their respective lines. A further result of the invention of this patent in suit is the securing of a positive testing system to enable any operator, to determine which of the several lines are in use, or free to be used. The invention of this patent has in its construction spring jack switches, annunciators, connecting plugs and cords, and supplemental devices combined with special and novel circuits, all designed to be operated in a particular way to secure the results referred to."

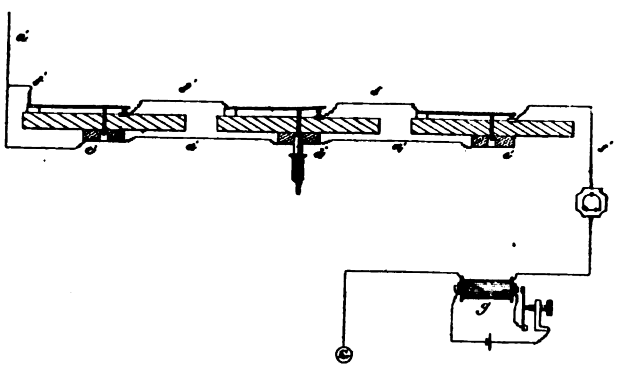
Mr. Scribner, on the witness stand, compared the defendants' system as used at Mobile with the invention of his patent as pointed out in claims 2, 4 and 6, and counsel for complainants characterizes as frivolous the attempts made by the defendants' witnesses to show any distinction, and states

that defendants' witnesses were constrained to admit the essential identity as to construction and mode of operation of the Mobile switchboard and the patent.

As regards the question of the prior state of the art, complainants contend that the other patents of Scribner, cited by defendants, Nos. 292,866, of February 5, 1884; 330,059, of November 10, 1885, and 330,060, of November 10, 1885, do not cover the subject matter of the patent in controversy. Besides, the two last patents cited above, four were issued on the same day as the patent sued on, and hence are deemed irrelevant as prior patents, the law recognizing no parts of a day. One of defendants' witnesses is also quoted as admitting that the getting rid of the feature of the separable contact points of the switches, which constitutes the principal and most important branch of the invention of the patent in suit, is not found in either of the three patents cited as anticipations.

Among the other anticipations urged by defendants in connection with the testimony of Mr. Paul Minnis, were the following patents: No. 252,259, January 10, 1882; C. W. Ross, No. 269,238, December 19, 1882; Shiras & Eckert; No. 294,482, March 4, 1884, Lytle & McCoy; No. 306,669, October 14, 1884, C. H. Wilson. Regarding these patents complainants contend that the patent in suit is essentially a patent for a new combination of what may be conceded are old elements when considered by themselves. The great majority of patents issued are of this character. One charged with infringement cannot, it is urged, justify himself by exploring the prior art and selecting from several different patents, the different elements of the combinations of the complainants' patent. Various authorities are cited in support of this contention.





FIGS. 1 AND 2 OF SCRIBNER'S PATENT NO. 330,061.

Mr. Scribner himself, on the witness stand, commented as follows on the patents cited above:

"As I have stated at the outset of this answer, in substance, none of these references is pertinent; in so far as they relate to multiple switchboards they show only what the specification of the patent in suit concedes to the prior art, and each of them, as I have stated specifically and in detail, contains the objectionable feature of including the contacts of the switches in the talking circuits when formed, which objection or defect is remedied by the invention of the patent in suit."

Taking up the question of infringement, the complainants dwell at length on the drawings of the exchange system furnished by Mr. F. R. Colvin, witness for the complainants, who visited the exchange at Mobile. In reply to the contention of defendants that Mr. Colvin's sketch of the electrical connections in the Mobile exchange showed a busy test arrangement that did not exist at the time of his visit, the complainants urge that the testimony of witness for defendant read in connection with the diagram of Mr. Colvin, shows that the system as operated at Mobile does contain a complete and operative test system, without which the switchboard employed there would be totally inoperative.

The complainants also contend that the defendants have copied so closely the structure described in the patent as to embody every detail set forth in claims 2, 4 and 6, and that such variations as do exist are mere equivalents; even upon the narrow construction contended for by defendants, the latter's apparatus would still contain the invention of the patent, their principal witness having been constrained to admit that defendants' apparatus contains the specific feature of normally open branches or contacts.

DEFENDANTS' ARGUMENTS.—The arguments of the defendants are briefly stated as follows:—

First: There is such failure and insufficiency in the proofs produced by the complainant to establish the charge of infringement that no just determination of that issue is possible.

Second: The state of the art prior to the grant of the patent in suit was such as to preclude the allowance of any claims having the scope and capable of the construction that can be inferred from the terms of said claims and from the face of said patent.

Third: By the well settled construction of the statute, no original patent should have been granted for the subject-matter covered, or defined, by the claims of the patent in suit; such subject-matter having been so far and so clearly disclosed by prior patents to the same grantee that the rights of the latter were thereby relegated to his remedy by reissue, and not to an original proceeding.

Fourth: The patent in suit is not infringed by defendants even if it be admitted, tentatively, that said patent is valid and capable of a broad construction.

Fifth: The patent in suit is void, save as to the seventh claim, under the decision of the U. S. Supreme Court in the case of Miller vs. Eagle Mfg Co., 151 U. S., 201, and Thomson-Houston Electric Company vs. Winchester Avenue Railroad Company et al., 73 O. G., 2,155, and authorities therein cited, and because of the reasons hereinafter set forth.

Sixth: If it be admitted, for the sake of argument, that the patent in suit has any life whatever, the claims in said patent can only be saved by the most narrow construction, rigidly restricting them to the precise form, construction and arrangement shown and described.

I. The whole prima facie case of the complainant rests upon the testimony of a single witness only, he being the only person called by complainant who pretends to have personal or actual knowledge of the things and circumstances to which he testifies. This witness is Frank R. Colvin, an employé of the complainant corporation. Colvin has testified that he was in the operating room of the Home Telephone Company about twenty-five minutes. In this short time he professes to have secured a perfect knowledge of every portion of the switchboard and every circuit upon it.

Colvin has furnished a species of illustration consisting in part of vertical sections and in part of diagrammatic illustrations of circuits. It is termed "Complainant's Exhibit Diagram Defendant's Apparatus," in which he professes to have incorporated what he saw in the defendant's telephone exchange. Concerning this exhibit he has testified: "I know it to be correct as a diagrammatic illustration." He also testifies that "immediately after having inspected the switchboard and having traced circuits of same, I understood the working of the board completely and minutely." Finally, not satisfied with these statements, he also swears: "During the time I was in the exchange I examined not only thoroughly but with great thoroughness" all points connected with wiring of the board.

The testimony of a number of competent, wholly disinterested and intelligent witnesses proves most positively that the so-called "diagram" is an embodiment of numerous errors, inaccuracies and false representations of the grossest character. It is shown that at the time of Colvin's entry to the exchange of the defendants, in Mobile, Mr. Minnis, who was with him during his entire visit, took the precaution of calling another person, Clayton B. Clark, the electrician of the Home Telephone Company, and enjoined him to keep close to Colvin and charge his memory with all that took place. Mr. Clark has testified as to the material and glaring errors and misrepresentations contained in the complainant's Exhibit C, and his testimony agrees, in all substantial respects, with Minnis'. The misrepresentations of the so-styled "diagram" are such as to wholly destroy the effect of the testimony produced in its support.

In reply to questions Colvin refers to the removal of the back of the switchboard, and in no part of his testimony does he express any uncertainty as to this point. John A. Couch, Clayton B. Clark and Paul Minnis all testify that they were in the Home Telephone office, or plant, at the time of Colvin's visit in July, 1896. Each witness swears positively that at the time of said visit there was no "busy test" circuit upon the defendant's switchboard, and that neither prior to said visit, nor subsequently, had there been any such thing upon the switchboard. Clayton B. Clark, who accompanied Colvin and Minnis in the examination of the board, and who had been specially instructed to hear and remember all that was said, testifies that not only was there no test circuit on the switchboard, but that Minnis told Colvin in his (Clark's) presence that a "busy test" could not be applied to said board. The witness swears absolutely and positively to this statement and to the further fact that Minnis did not, during Colvin's stay in the exchange, offer or attempt to show him a test of that kind; that "nothing of the kind was done." Mr. Minnis has described with particularity what took place in the exchange during Colvin's visit. He corroborates Clark in every point.

It is shown also by testimony that cannot be disputed that Colvin's description of the removal of the "back of the switchboard" to expose the wiring is upon all fours with the other parts of his testimony. It appears that this switchboard never had any backing of any sort, and the removal of the latter, which is so often described by Colvin with such repetition of detail, never had any existence except in his own fertile imagination.

Regarding testimony of the character given by Colvin it is submitted the whole is valueless on the principle of the legal maxim, "falsus in uno, falsus in omnibus."

It must be observed, also, that all of the witnesses called by these defendants are not only experts, but that they are without interest in the result of this litigation. Full credit, therefore, must be given to each of them.

The desertion of its own position by the complainant proves beyond question that the entire foundation upon which the suit was originally built has been swept away, and that in the desperate struggle to keep the litigation alive the best that could be done was to attempt, by irrelevant evidence, unwarrantably introduced on rebuttal, to "borrow" planks from the structure of proof erected by defendants upon which to sustain such hope as remained of being able to show the court that, although defendants are not using the arrangement shown in the drawing made, and described and sworn to in the testimony given by their witness Colvin, they are nevertheless using an arrangement which complainant's counsel claims to be the equivalent of that shown and described by their witness Colvin.

II. The patent in suit is for an invention which is an improvement in degree only upon prior inventions, and in said patent the elements of the several combinations are specifically disclaimed, or admitted to be old. The case falls, therefore, under the rule stated in Glover, Sanford et al. vs. Merrimac Hat Company, 2 Bann. and Ard., 408, and Le Roy vs. Tatham, 22 How., 132. This ruling is that—

"Where the invention consists entirely in a new combination of old elements or ingredients the law is well settled that a suit for infringement cannot be maintained unless it appears that the respondent has used all the elements or ingredients of the new combination."

The acknowledgments of the patentee as to the novelty of the elements he was dealing with are found in lines 51, 52, on page 1, of the printed specification. Now, if we examine closely into the exact novelty of the claims in this patent we shall find that the margin of difference between it and the invention in patent No. 321,390, to the same patentee, is not easily defined. The multiple wiring in the latter is identical with that in defendant's exchange.

The patents of Ross, No. 252,259, January 10, 1882, and those of Scribner, No. 330,359 and No. 330,360 are cited as anticipations of the patent in suit. These patents contain every element found in the patent in suit, except the eccentric switch, which is found, however, in patent No. 330,060.

Let us take the jack shown in the Ross patent No. 252,259 and substitute it for the jack shown in either of Scribner's patents Nos. 330,059 or 330,060. This, also, would give us in every particular the exact combination of the claims in the patent in suit.

It may well be asked, of what importance to the combinations in the patent named is the insulation which isolates the spring switch from the metallic frame? Or, in other words, why should this device be in electrical connection with the metal frame in patent No. 292,806 and insulated from it in 330,061; or, for that matter, in 330,060 or 330,059? What would be the result of removing the insulation around the spring switch in any of these patents? Clearly it would act in precisely the same way in both forms. That this view of the construction is correct beyond all disputation is shown by the second figure of the drawings in the patent in suit. In said figure we find no insulation whatever around the spring switch, but a non-conducting bolt lies in the jack and is pushed by the plug against the spring to open the circuit of the annunciator.

This fact establishes beyond contention that the substitution of the Ross jack for the jack in patent 330,060 would be entirely feasible, and would not even require ordinary mechanical skill. The production of the invention in the patent in suit was not a matter requiring inventive skill. It was accomplished by others who never considered it a subject for a patent.

The line being connected directly to the body of the jack and a tap or branch taken from it directly above the jack and connected to the spring switch, we have an arrangement exactly equivalent in all respects to that produced by simply removing the insulation from the spring. This view was taken by the Patent Office when the application for the patent in suit was pending. Why it was not adhered to can only be understood by remembering that the Patent Office is fallible, like all human institutions.

We also refer the court to the recent decision of the U. S. Supreme Court in Miller vs. Eagle Manufacturing Company et al., 151 U. S., 186, and to the case of the Thomson-Houston Electric Company vs. Winchester Avenue R. R. Co., 73 O. G., 2,155, in which the authority first cited is examined and explained.

III. In Magin vs. McKay, 24 Fed. Rep., 743, it was said that:

"Prior use of articles less perfect, but identical in principle, invalidates a patent."

Authorities can be cited by volumes showing the close scrutiny the courts are exercising in patent litigation in order to establish the validity of their claims and determine the construction to be given the same. It is unnecessary to say that in cases where the alleged novelty is of a character which negatives the presumption that inventive effort was necessary for its production the claim or claims to such features must be declared invalid.

V. It is well settled that where the evidence of infringement is not clear it is insufficient. (Hill vs. Holyoke Envelope Co., 20 Fed. Rep., 683; Rey vs. Ram, 16 Fed. Rep., 749.) Also that in combination claims the absence of a single feature recited in said claims will overcome the charge of infringement. (P. H. Murphy Mfg. Co. vs. Excelsior Car Roof Co., 76 Fed. Rep., 965.) We have already directed attention to the fact that where a patent covers merely combinations of old elements the law is well settled that a suit for infringement cannot be maintained unless it appears that the respondent has used all the elements or ingredients of the new combinations. (Glover, Sandford et al. vs. Merrimac Hat Co., 2 Bann. and Ard., 408, and Le Roy vs. Tatham, 22 How., 132.) It is settled, also, that "when the state of the evidence is such as to leave doubt in men's minds the doubt will be resolved in favor of the defendants and they will be held not to infringe." (Mallory Mfg. Co. vs. Hickok et al., 25 Fed. Rep., 827. (1885) Shipman, J.)

It having been clearly shown by the proofs referred to that there was absolutely no "busy test" upon defendants' board, it follows that they cannot be charged with trespassing upon any claims in the patent in suit in which testing apparatus is made an element. Therefore, they cannot be charged with infringement upon the first, third and fifth claims in patent No. 330,061.

As to the remaining claims expert witnesses agree that defendants have, in their apparatus, no "normally open branch," or any equivalent thereof.

TELEGRAPHERS AND YELLOW FEVER.

Every announcement of the arrival of a vessel at an American port with cases of yellow fever on board sends a thrill through the telegraph operators of the country, especially those employed in Philadelphia and other Pennsylvania cities, the "Press" says. In 1878, when the "saffron scourge" was almost depopulating the cities of the South, hundreds of Southern operators died, and, as the mails had been quarantined, there was a possibility for a time that all communication between the North and South would be shut off. Although the Western Union Company did not ask for volunteers among Northern operators to go South to keep communication open, seven men offered their services. Four were employed in Pittsburg, two in Philadelphia and one in Boston. The four Pittsburg men went to Memphis and all died of the fever within a few days after their arrival. The Boston man started for New Orleans and accidentally shot himself in a

New York hotel. One of the Philadelphians, on his way South, was arrested and sent to jail in St. Louis on a trumped-up charge preferred by his mother, who took this means of preventing her son from risking his life. The seventh volunteer, also from Philadelphia, reached New Orleans safely, was not ill a day and was the only one that reached the yellow fever country that year and returned alive.

ELECTRIC MOTORS IN FARRELL FOUNDRY AND MACHINE CO.'S SHOPS, ANSONIA, CONN.

An interesting example of electric drive in a heavy machinery works, is that found in the shops of the Farrell Foundry and Machine Company, at Ansonia, Conn., the electricity being taken from turbine driven generators located nearly three miles away.

Previous to the development of the water power, the generating plant of the Farrell Foundry and Machine Company consisted of two 75 k. w. six-pole, 275-revolution, 500-volt dynamos, directly coupled to 100 h. p. Ames engines, and one four-pole, 65 k. w., 220-volt generator, driven by belt. The latter still furnishes current to three traveling cranes, the former during a short space of time only during the year drives the different motors scattered throughout the shops. This plant was purchased before the Derby Gas Company arranged with the Farrell Foundry and Machine Company to supply it with current from its power station at the Housatonic Dam, where it utilizes the excess water flowing over the dam. The Derby Company having two four-pole, 200 k. w., 550-volt machines and being thus in a position to supply power, made a favorable arrangement with the Farrell Company.

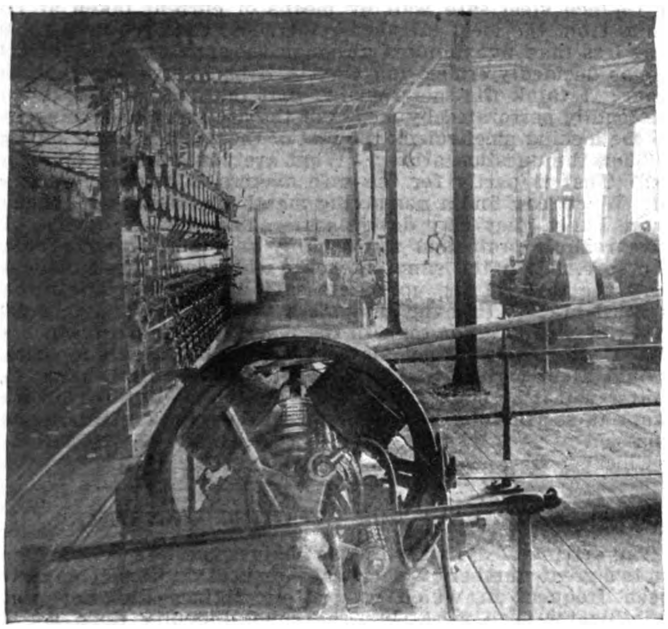


Fig. 1.—Power Station, Farrel Foundry and Machine Co., Ansonia, Conn.

Both dynamos being direct current machines, and the length of the transmission nearly three miles, they are coupled in series to secure the necessary pressure, and deliver current at the brushes at 1,100 volts. At the switchboard, at Ansonia, the pressure is 1,000 volts. The distribution is carried out on the Edison three-wire system, and as half the motors in the works are connected to each side of the system, the working pressure of each motor is 500 volts.

In the engine room at Ansonia is a switchboard of the panel type, arranged not only for the complete control of the motor plant operated from Derby, but also for the isolated plant of the Farrell Company. The two 75 k. w. generators in the Farrell works are used for about two months only in the year, the current from the Housatonic Dam being used for the other ten months. The first two panels control the two 75 k. w. generators; the third is an "Outside Supply" panel and then come ten panels, each controlling two motors.

The motor equipment consists in all of nineteen motors of the following horse-power and speed: Three 35 h. p., 525 revolutions; five 10 h. p., 325 revolutions; five 15 h. p., 312 revolutions.

They are all of the four-pole type, and for the most part are located directly over the floor of the shop on platforms suspended from the roof girders. From these the belts are taken to the shafting below, whence the various machines are driven. The illustration, Fig. 2, shows six motors set on platforms in the new machine shop. They range in capacity from 10 to 35 h. p. Directly beneath them is the path of one of the traveling cranes. Other motors are attached to the wall, and a few are on the main floor near the walls.

The machinery manufactured by the Farrell Foundry and Machine Company is of a peculiarly heavy type and the machines driven by the motors are of various characters and sizes, subjected to sudden, heavy and fluctuating loads, yet according to the officers of the Farrell Company, the plant, running since October, 1895, has, not only given complete satisfaction, but no repairs either to generators or motors have been found necessary during the eighteen months in which the system of electrical drive has been in operation. The heavy ore and rock crushers made by the Farrell Company are used in all parts of the world, while their mills and heavy calendar rolls are found in nearly every rubber mill in the United States.

The economy induced by the introduction of the electric motors is perhaps best illustrated by the result obtained in the roll shop. This was previously run by a 250 h. p. Buckeye engine, usually loaded to its full capacity. The same rolling machinery, as well as a variety of other machinery, is now driven by motors, taking a total power of from 125 h. p. to 150 h. p.

The 65-kilowatt, 250-volt generator supplies as stated above the current to operate three traveling cranes and several jib cranes. The machine is also subjected to very wide fluctuations of load, sometimes extremely severe. Under service of this character the ordinary generator might be expected to give some dissatisfaction, yet it operates without the least

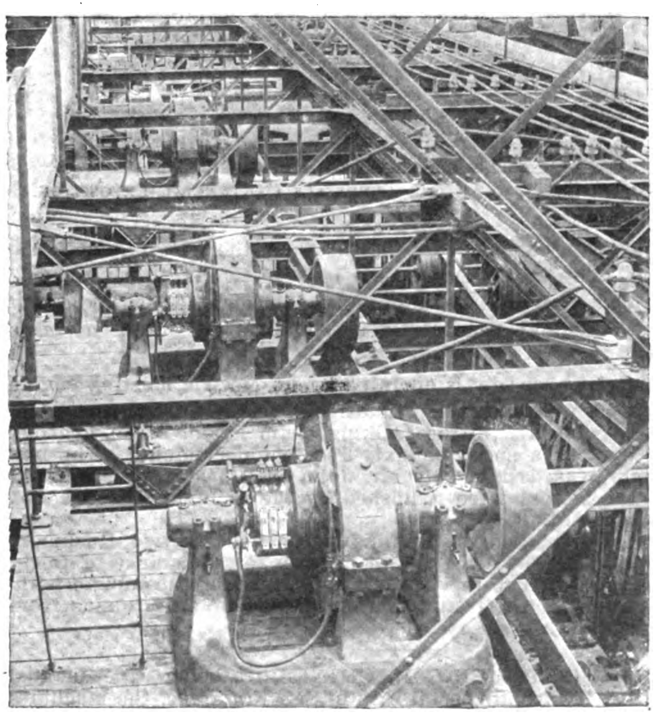


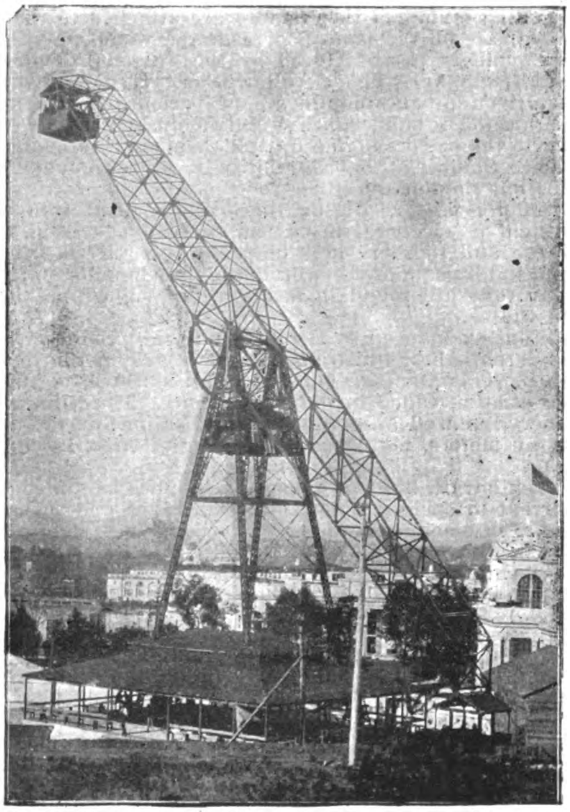
Fig. 2.—Six 500-Volt Motors Attached to Roof Girders in New Machine Shop, Farrel Foundry & Machine Co., Ansonia, Conn.

sparking and without necessity of changing the brushes, under any change of load.

The entire electrical plant was furnished by the General Electric Company.

THE GIANT SEE-SAW AT THE TENNESSEE CENTENNIAL.

PARIS has had its Eiffel Tower, Chicago its Ferris Wheel and the Tennessee Centennial at Nashville has as its great land-mark the Giant See-Saw. This unique structure was designed and constructed by Mr. A. J. Dyer, a prominent engineer of Nashville, the steel work being furnished by the Schultz Bridge Company, of Pittsburg, Pa. The tower rests on stone foundation running down to solid rock, and is 100 feet high, while the truss beam, from either end of which a car capable of carrying twenty-five people is suspended, is 200 feet long, thus giving a maximum height of 200 feet, from which point a most magnificent view of the Cumberland Valley can be had. In the distance, the "Hermitage," the home of Andrew Jackson, can be seen, while "Belle Meade," the forts and battlefields of Nashville, together with the city and Centennial grounds lie in beautiful panorama at one's feet.



GIANT SEE-SAW AT THE TENNESSEE CENTENNIAL EXPOSITION.

The giant see-saw is operated by an electric hoisting engine equipped with a 10 h. p. multipolar motor direct connected, and is connected to the walking beam by means of gearing. The car has a speed of sixty-five feet per minute. The machinery was designed by Mr. John W. Chester, of Nashville, and the motors were furnished by the Triumph Electric Co., of Cincinnati, O.,

A novel method of illuminating is had by two Rushmore searchlights; these lights can be seen for a distance of thirty miles. No visit to the Centennial is considered complete without a view of the beautiful illumination of the grounds from the top of the see-saw.

LETTER-STAMPING MACHINES are being experimented with on the trolley postal cars in San Francisco, the machines being run by motors that take current from the trolley circuits.

BROOKLYN TROLLEYS carried 700,000 passengers on Monday, July 5, and not a single accident of any importance occurred. The Sunday travel was almost as large and probably reached 600,000 passengers. The cars were run on the shortest possible headway, but even then had twice as many fares as the law allows. There was no keeping the people off.

LETTERS TO THE EDITOR

SAFE BURGLING BY ELECTRICITY.

THE editorial in your issue of July 8 as well as some remarks in earlier numbers would imply a forgetting of that apt phrase of Dr. Holmes: "There somewhere is always a weakest spot." It seems to me that the burglar who is sufficiently wideawake to employ electricity for his work will also be bright enough to know the weak spots in a safe mechanism. All the safes with which I am familiar have the bolt movement controlled by detents in the shape of a series of washers or "tumblers," which are light and rather frail, so that they could easily be forced off the supporting shaft by a few well directed blows. Then when they are displaced the safe can be opened by merely throwing the handle, without the use of any explosives. All the intruder would want of the current is a means of getting access to this weak spot in the locking mechanism of the safe; he knows just where the tumblers are located and a fairly small hole through the door will be ample for introducing a tool with which to destroy the detent.

That such a hole can be readily burnt through the safe door by means of an arc, has been well affirmed by writers in your columns. I myself have seen a ¾-inch hole burnt through a 1½-inch steel safe wall by means of current taken at 110 volts from the local Edison circuit. The time required for it was less than five minutes, although the apparatus used struck me as decidedly crude; and what if it had taken, say, half an hour? I think the fact remains that the door of a safe can be readily perforated by means of the arc so as to give access to the locking mechanism; the rest of the work is plain sailing.

Then the question arises: "What are you going to do about it?" That is partly for the safe makers to answer; perhaps Mr. Wurts can find a non-arcing metal for them. Or, what is more likely, they may devise some alarm devices which will give reliable protection against any sort of tampering with the safe. Then the same agencies which are threatening to ease the work of the up-to-date safe breaker may be turned against him, so that the banker's safeguard may lie in a network of wires rather than in the massive plates on which so much reliance has been placed in the past. Such a change would seem logical, and the sooner it is brought about the better will it be not only for the safe owners, but for all who want to see the electric current used only for legitimate purposes.

ALBERT SCHEIBLE.

Chicago, Ill.

GAS ENGINES FOR ELECTRIC LIGHTING.

The driving of dynamos by gas engines has been commented on in a great number of electrical papers. Doubtless there have been frequent in which gas or oil engines did not prove suitable for such work, but the chief difficulty does not lie with the gas engine in general, but with some of the makes selected for dynamo-driving. If, therefore, an engine be chosen especially designed for electrical work, the result will be quite a satisfactory one.

Most gas engines are built on the hit-and-miss principle of regulation. To keep the speed fairly steady—especially at light loads—a one cylinder engine has to run at a very high speed and must be provided with heavy flywheels and a sensitive governor. Frequently two cylinders are coupled together, and the result obtained in regard to steadiness of speed is in most cases a good one. This construction is rather expensive for smaller engines and materially complicates the machines, so that—at present—the best solution seems the use of another system of speed governing of single cylinder gas engines.

Having tested, within the last four years, a great number of gas engines driving dynamos, I can state that the regulation of the speed by varying the quantity (not quality) of the explosive charges must be considered the most successful. Some of the engines working on the hit-and-miss principle of speed regulation showed, between explosions, a continuous speed variation corresponding to a change of from 4 to 10 volts on a Weston voltmeter, while engines regulated by varying charges gave variations of ½ to ⅓ volt, a result which compares favorably with the working of good steam engines.

Last winter I took occasion to study the working of a 10 h. p. gas engine designed by Mr. H. Carnell, of Dayton, O., for electric light work. The maximum variation of the voltage was less than ½ volt, and a tachometer indicated a greater variation (in per cent.) of the dynamo speed than of that of

the gas engine. The dynamo, however, was running under very unfavorable conditions, as its position was much too low and the dynamo pulley was of very small size in order to attain the proper speed without countershafting. The engine was easily started and never failed to work the time that I saw it in operation in Dayton.

A great many of the failures in gas engine plants must be attributed to the insufficient size of the gas engines employed, and since a great many of such cases occurred to me, it seems that a closer attention should be paid by the purchaser of a gas engine to the actual (brake) horse power of such machines.

DR. G. H. BENNETT ZAHN, C. E.

Berlin, July 3, 1897.

ROENTGEN RAYS

PROF. ROENTGEN'S LATEST RESEARCHES.

Prof. Röntgen has again made a communication to the Royal Academy of Sciences on his great discovery. He states that while the X-rays are passing through the air they traverse it in every direction. When a plate impervious to the rays is placed between a fluorescent screen and a source of the rays, so that the screen is overshadowed by the plate, the platinocyanide of barium nevertheless becomes luminous, and this luminosity is visible even when the screen lies directly upon the plate, so that one might imagine that some rays had traversed the plate; but if the screen placed on the plate is covered by a thick piece of glass the fluorescence becomes weaker and disappears completely when the glass is replaced by a cylinder of lead 0.1 centimetre (equals 1-25th of an inch) in thickness surrounding the fluorescent screen. Prof. Röntgen's explanation of this phenomenon is that X-rays emanate from the irradiated air. He considers that if our eyes were as sensible to the X-rays as to ordinary light the appearance would be as if a candle were burning in a room filled with tobacco smoke. Prof. Röntgen has, moreover, invented a new apparatus for measuring the intensity of the X-rays. He has succeeded in ascertaining by means of this apparatus that the intensity of the rays is influenced: (1) by the course of the primary current; (2) by the interposition of a Tesla transformer; (3) by the rarefaction of the air in the tube, and (4) by some other agencies not yet known. He concludes: (1) that the rays issuing from a discharging apparatus consist of a mixture of rays of different absorbability and intensity; (2) that the combination principally depends on the course of the discharging current; (3) that the absorption of the rays varies according to the absorbing medium, and (4) that as the X-rays are produced by the cathode rays, and have similar fluorescent, photographic and electrical qualities, it is very probable that they are both phenomena of the same nature.

NATURE OF ROENTGEN AND OTHER RAYS.

An elaborate paper on the subject of Röntgen rays as compared with other occult types of radiation has been read before the Heidelberg University by Julius Precht. He reproduced several photographs tending to show that the bending of cathode rays in a magnetic field is strictly in accordance with the Biot-Savart law and the theory of electrodynamic tension. Goldstein's "canal" rays hold a distinct place with regard to both cathode and Röntgen rays. They are not deflected by a magnet, and they have no powers of exciting fluorescence or photographic action. Röntgen rays show various properties with regard to absorption which have not yet been noticed. Metals, glass, and crystals absorb them to a different extent according to the percentage of slight impurities, and also according to the structure of the molecule. They are capable of altering the resistance of a selenium cell to the extent of 32 per cent. The decomposition of dry salts by the rays of the second cathode layer, as observed by Goldstein, cannot be obtained by the Röntgen rays. An important point is raised by the observation that the amount of absorption by paper undergone by the Röntgen rays depends upon the time during which the radiation lasts. The author regards a portion of this action as purely electrical, and concludes that part at least of the rays proceeding from the discharge tube does not consist of wave motion. In this conclusion, and in the surrendering of the argument from the absence of effect upon the magnetic needle, there is a distinct step toward what is known as the English view. On the other hand, the author claims certain interference phenomena for Röntgen rays, and tries to determine their wave length à la Fomm and Sagnac. By the interference of a direct ray and a ray reflected at grazing incidence by a lead plate he obtains the values of 370 $\mu\mu$ and 830 $\mu\mu$ for two experimental arrangements. These, it will be noticed, are the two extreme limits of the visible spectrum. Here there is a difficulty to solve, for if these rays are transverse ether vibrations of the frequency of light, they should be distinctly visible to the ordinary eye. The dilemma may be escaped from by assuming that the vibrations are not transverse, but longitudinal. The author inclines to accept this view rather than doubt his wave length determinations.

LUMINESCENCE.

A valuable and systematic investigation of luminescence phenomena as produced by all sorts and conditions of rays has been carried out by W. Arnold. The rays employed comprise light, cathode, Röntgen, Becquerel, "canal," and discharge rays, and the substances examined include sulphides, selenides, tellurides, organic bodies and solid solutions. Among the results obtained there is a noteworthy proof that the results obtained with solid solutions cannot be obtained by a mere intimate mechanical mixture of the two substances. Further, there is a very decided difference in the luminescence of various bodies under the influence of cathode rays and X-rays, respectively. This is prominently brought out by the solid solutions of manganese sulphates in other sulphates which are quite indifferent to Röntgen rays. A similar discrimination is shown by anthracene, toluidine, benzoic, salicylic and hippuric acids, and other organic bodies, including bacteria. The most brilliant solid solutions fail to send out Becquerel rays. One hydrocarbon—retene—does emit them, whereas closely allied bodies like anthracene and anthraquinone do not. The "canal rays," first obtained by Goldstein from the red cathode rays by perforating the cathode, have some remarkable properties. They are not deflected by a magnet, but, like the cathode rays, they are capable of producing an intense luminescence, which is, however, only temporary, as the bodies rapidly lose this property under their influence. Apart from this difference from the cathode rays, they are distinguished from X-rays by their lack of photographic action. They are, however, capable of discharging bodies electrified either positively or negatively. Their energy is very great, as shown by their heating effect. It is possible that the heating of the unperforated cathode is chiefly due to them. The phenomena of luminescence offer a valuable test for distinguishing between the various types of rays.

SOCIETY & CLUB NOTES

A. A. A. S. MEETING AT DETROIT.

The meeting of the American Association for the Advancement of Science to be held at Detroit, August 9 to 14, promises this year to be of unusual interest to electricians, and it is expected that a large number will attend. Prof. A. G. Greenhill, of Woolwich; Prof. J. V. Jones, of Cardiff, and Profs. John Perry and W. E. Ayrton, of London, have signified their intention to be present and participate in the proceedings of the Physics Section. The names of Mr. C. P. Steinmetz, Mr. Chas. F. Brush, Prof. H. S. Carhart, and other eminent electrical engineers are on the programme. Those who wish to be present at the meeting and are not already members should apply to Dr. Frederick Bedell, secretary of the section, Ithaca, N. Y., or to Prof. Putnam, the permanent secretary, Salem, Mass.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION.

A very interesting historical sketch has been issued of the work done in making the rules that govern electric light and power work in this country. It bears the names of Prof. F. B. Crocker and Mr. C. M. Goddard, and has been prepared by the Code Committee of the National Conference on Standard Rules and the Committee on Press of the Underwriters' Na-

tional Electric Association jointly. Our readers are familiar with the course of events here narrated, but many of them will probably be glad to secure a copy of this record in its succinct and handy form.

OBITUARY

PROF. ALFRED M. MAYER.

Alfred M. Mayer, professor of physics in the Stevens Institute of Technology, Hoboken, N. J., and one of the leading physicists of this country, died on July 13, at his residence in Maplewood, N. J., after a protracted illness. He was born in Baltimore, Md., November 13, 1836, and was educated at St. Mary's College in that city, from which he graduated in 1854, entering the workshop and drafting room of a mechanical engineer, where he remained two years. He then devoted two years to the study of analytical chemistry. When he was little more than 20 years of age he was called to the chair of physics and chemistry in the University of Maryland, and three years later accepted a similar position in Westminster College, Missouri, where he remained for two years, and then went abroad to complete his scientific education at the University of Paris. There he studied physics, mathematics and physiology under Regnault, the great French scientist. Returning from Paris, he was appointed to the chair of physics in Pennsylvania College, at Gettysburg, and subsequently held the chair of physics and astronomy at the Lehigh University,

Prof. Alfred M. Mayer.

Bethlehem, Pa. On the organization of the Stevens Institute of Technology, in 1872, Professor Mayer accepted the professorship of physics at that institution, which was filled by him from that period up to the time of his death.

His scientific researches since that time have been principally published in the American Journal of Science, under the title of "Researches in Acoustics." These include a method of detecting the phases of vibration in the air surrounding a sounding body, mode of measuring the wave lengths and velocity of sound in gases, resulting in the invention of an acoustic pyrometer; the determination of relative intensities of sound; five new methods of sonorous analysis for the decomposition of a compound sound into its elementary tones, and several other important discoveries in the field of acoustics.

One of his most important contributions to the physics of music is a paper on "The Determination of the Law Connecting the Pitch of a Sound with the Duration of Its Residual Sensat on." Other treatises he published were: "On the Effects of Magnetization in Changing the Dimensions of Iron and Steel Bars," "Experiments with Floating Magnets" and "On Measures of Absolute Radiation." His most recent work was devoted to the investigation of the phenomena of floating polished metal rings. In all, he was the author of nearly 100 articles and pamphlets dealing with the several branches of science which he devoted nearly all his life. Professor Mayer was of a strong mechanical turn, and invented a number of machines and apparatus used in the laboratory of the physicist. In 1866 he received the degree of Ph.D. in the Pennsylvania College, and six years later was elected a member of the National Academy of Sciences. He was also one of the associate editors of the American Journal of Science and a member of a number of scientific associations.

PERSONAL

PROF. R. B. OWENS, of the University of Nebraska, is a visitor to New York, en route to the Institute meeting at Greenacre, Me. He has been very successful in his work of securing exhibits as Commissioner for the Electrical Section of the fine Exposition to be held at Omaha next year.

MR. H. N. FENNER, of the New England Butt Works, Providence, R. I., went abroad recently with his wife for a summer holiday.

MR. C. O. MAILLOUX, accompanied by his wife, has gone abroad on a short trip.

MR. H. B. COX sailed for Europe last week on the "Campania," hoping soon to return to the United States, where he has been much gratified with his reception.

LEGAL NOTES

JUDGE CULLEN, of the Appellate Division of the Supreme Court in Brooklyn, has decided that the franchise of the Brooklyn City Railroad is not a taxable asset.

THE BELL TELEPHONE COMPANY, of Philadelphia, has secured a decision from the Common Pleas Court, to the effect that the city must grant permits to erect poles at certain points; and a writ of peremptory mandamus is issued.

CAR SPEED. The Appellate Court has sustained the decision of the County Court, which fined the Nassau Electric Railroad Co. $25 for running a car faster than the authorized speed of ten miles an hour.

THE STOCK MARKET

CLEARING SKIES.

THE conditions of the country, the tone of the stock market, and the general outlook in agriculture and trade, all mark the beginning of a better state of affairs. In fact, it might be said that evidence had been given of this improvement for some time past, but while this is true, no deep impression had been made in any quarter. For some time to come the old complaints will be heard, and there will here and there be justification; but the attitude of the public is that of cheerful hope, and the broad movement is towards a large prosperity.

Last week 10,949 shares of Western Union were sold up to 85⅛. Of General Electric, 10,796 shares were sold, up to 34¾; and American Bell Telephone on sales of 224 shares rose to 229½.

Copper ingot is quoted at 11⅛c. to 11¼c. for Lake, 10¾c. for electrolytic, and 10½c. for casting.

RAILS are quoted at $19 for heavy steel, and $24 to $28.50 for light sections.

BOILER TUBES. At a manufacturers' meeting in New York, July 13, the following scale was adopted:

	Discount. Per cent.
Merchant Boiler Tubes, 2½ and larger	.80
Merchant Boiler Tubes, smaller sizes	.77½
Charcoal Iron Boiler Tubes, 2½ and larger	.75 and 5
Charcoal Iron Boiler Tubes, smaller sizes	.72½

An additional 5 per cent. is given to the trade.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 13, 1897.

Alarms and Signals:—

THERMOSTAT. O. Wiederhold, Summit, N. J., 586,301. Filed November 14, 1896.
Comprises a thermostat and thermostatic alarm arrangements particularly applicable to dynamos and motors.

Batteries Primary:—

PRIMARY BATTERY FOR BICYCLE LAMPS. T. F. Boland & H. C. Hubbell, Elmira, N. Y., 586,416. Filed December 24, 1896.
Comprises the casing, a metallic rod, the lower end of which is embedded in the bottom of the casing, while its upper end is vertically slotted, and a zinc element provided with a hollow seat, to adapt it to fit over the metallic rod.

Conductors, Conduits and Insulators:—

RACEWAY FOR ELECTRICAL CONDUCTORS J. H. Bleoo, Brooklyn, N. Y., 586,282. Filed April 13, 1897.
A raceway for the reception of a bare electric wire, the raceway having an exposed inner metallic surface and capable of being bent in combination with means for insulating the raceway from surrounding objects.

INSULATOR. H. W. Steinberg, Jr., Walla Walla, Washington, 586,372. Filed December 3, 1896.
Consists of a block of glass or other insulating material, a screw secured in the block, by means of which the same may be attached to a suitable support, the block being further provided with an irregularly-shaped slit in its upper end in which the line wire is adapted to fit, and with an opening extending laterally through the block and passing through the slit at a point just above its lower end, and a securing wire fitting within the opening.

JOINT PIECE FOR ELECTRICAL CONDUCTORS. E. Ivins, Philadelphia, Pa., 586,439. Filed November 11, 1896.
Consists of a seamless tube having its sides indented so as to form three independent tubes arranged in triangular form.

CABLE HEAD FOR ELECTRIC WIRES. H. A. Tobey, Toledo, Ohio, 586,464. Filed March 5, 1897.
A casement and an annular disc secured in the casement for affording ready access for change in wire connections, the disc provided with means for connection of the wires.

CABLE HEAD FOR ELECTRIC WIRES. H. A. Tobey, Toledo, Ohio, 586,464. Filed March 5, 1896.
Similar to above.

Dynamos and Motors:—

DYNAMO ELECTRIC MACHINE OR ELECTRIC MOTOR. A. R. Grieboy, Baltimore, Md., 586,234. Filed June 2, 1896.
A radial-pole armature machine capable of working either as a dynamo or motor in series, shunt, or compound wound.

DYNAMO OR MOTOR. A. W. Smith, Washington, D. C., 586,459. Filed May 3, 1897.
Employs a field magnet having on one side of its neutral point a single wide pole and on the other side of the neutral point several plural poles, the plural poles forming between them coil containing spaces.

COMMUTATOR-TRUING DEVICE. Percy B. Bosworth, Fort Wayne, Ind., 586,514. Filed December 17, 1896.
Details of construction.

Electro-Metallurgy:—

PROCESS OF AND APPARATUS FOR ELECTROREFINING COPPER OR OTHER METALS. C. R. Fletcher, Boston, Mass., 586,171. Filed January 27, 1892.
The method consists in heating the cathode of an electrodeposition tank, by introducing steam into the hollow interior of the same, and superheating the steam by passing a current of electricity through resistance coils contained within the cathode.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. B. A. Stowe, Cleveland, Ohio, 586,208. Filed December 28, 1896.
Comprises the carbons, the globe and a light obstructing device at a point within the globe which is at all times in the light field space of the arc.

INCANDESCENT ELECTRIC LAMPS. H. F. Schaedel, Cleveland, Ohio, 586,275. Filed July 6, 1896.
Contains two carbon filaments, with a common return circuit.

ELECTRIC LIGHT FIXTURE. L. McCarthy, Boston, Mass., 586,-317. Filed March 18, 1897.
Employs an intermediate insulating disc between the canopy and ceiling formed with an annular groove in which the edge of the canopy rests.

ADJUSTABLE SUPPORT FOR INCANDESCENT ELECTRIC LIGHTS. C. A. Carmany, Ephrata, Pa., 586,378. Filed March 22, 1897.
Details of construction.

ELECTRIC LAMP FOR VEHICLES. M. P. Ryder, Westfield, N. J., 586,399. Filed September 10, 1896.
Comprises a headlight supplied with current by a magneto-electric generator adapted to fasten to the fork of a bicycle and adapted to be driven by friction with the wheel.

ARC LIGHT HOLDER. Chas. A. Haney, Pittsburg, Pa., 586,435. Filed February 19, 1897.
Comprises a pole and cross-arm and means whereby the lamp may be readily moved to any position on the cross-arm.

Miscellaneous:—

PROCESS OF ELECTROLYTIC DECOMPOSITION OF SOLUTIONS. L. P. Hulin, Modane, France, 586,236. Filed July 6, 1894.
Consists in subjecting an electrolyte to the action of porous electrodes having only one electrically active surface exposed to the pressure of the electrolyte while the other electrically inactive surface is subjected to a lesser pressure and gives passage to the ions.

ELECTRIC IGNITER FOR GAS ENGINES. Harry S. Dosh, Baltimore, Md., 586,479. Filed February 17, 1897.
Comprises two electrodes having their ends formed as extended plates and means for suddenly separating the plates thereby causing a rarefaction of the gaseous medium between them.

ELECTRIC TELPHER TOWING SYSTEM. H. F. Gray, Passaic, N. J., 586,516. Filed February 14, 1894.
Comprises a series of poles located outside of the tow-path and braced against lateral and longitudinal strains, electric tracks or cables, one mounted upon the braces and another upon the tracks, and means for connecting the motor to a canal boat.

ELECTRIC GAS LIGHTER. F. Rhind, Bridgeport, Conn., 586,537. Filed May 17, 1897.
Details of construction.

Railways and Appliances:—

TAKE-UP DEVICE FOR TROLLEY CORDS. A. J. Wood, Springfield, Mass., 586,302. Filed April 9, 1897.
Comprises a spring actuated roller enclosed within a casing.

ELECTRIC RAILWAY SYSTEM. L. K. Devlin, Havre, Montana, 586,422. Filed May 24, 1895.
Sectional conduit system.

Switches, Cut-Outs, Etc.:—

METHOD OF AND MEANS FOR SUPPORTING AND INSULATING ELECTRIC CONDUCTORS. H. W. Leonard, East Orange, N. J., 586,133. Filed February 13, 1897.
A method for use in the construction of rheostats by which the conductor is attached to the support by adhesive material which permits expansion in the conductor without serious strain to itself.

Telegraphs:—

TRANSMITTING ELECTRICAL SIGNALS. G. Marconi, London, England, 586,193. Filed December 7, 1896.
A receiver for electrical oscillations combining an imperfect electrical contact, a circuit through the contact and means actuated by the circuit for shaking the contact.

Telephones:—

SWITCHBOARD. C. E. Egan, Chicago, Ill., 586,285. Filed May 1, 1897.
Comprises a jack made flexible to permit it to be moved in effecting the electrical currents, and a drop magnet mounted upon and movable with the jack.

TELEPHONE SYSTEM. W. W. Davis, St. Louis, Mo., 586,529. Filed September 5, 1896.
Means whereby one station may communicate with another without the aid of an attendant at the central exchange.

NEWS AND NOTES

THE ELECTRICAL ENGINEER IN THE COLLEGES.

As the oldest electrical paper in the field, The Electrical Engineer has built up a very solid clientage among readers and advertisers, and stands foremost as the representative journal in the art and industry. What central stations think of it will be found in a pamphlet of opinions, which we shall be glad to send to any address on application. Below we give the opinion, bearing date June 23, 1897, of one of the leading technical teachers of the West, Prof. Edgar Kidwell, Michigan Mining School, Houghton, Mich. Note what he says:

I like the paper for the following reasons:

1. To a greater extent than any other American electrical paper I read, The Electrical Engineer is true to its name, and edited for engineers, not physicists, amateurs or electricians only.

2. In the judgment of the writer, any electrical education not founded upon sound mechanical engineering training is ill-advised. The Electrical Engineer seems to recognize this, and select its matter accordingly.

3. Higher mathematics is an excellent thing in its place, but I question whether it is good policy to load up the columns of an engineering journal with abstruse mathematical discussions on matters irrelevant to engineers—particularly controversies of no interest except to those who take part. The Electrical Engineer is happily free from such matter.

4. The paper sticks to the text—I am about tempted to call it the "Old Reliable," because it never chases out of its course to gather in a lot of popular stuff which is beautiful for padding, impressive to the general advertiser who likes bulk, catchy to the layman, but apt to make the engineer wonder what real value he is getting from his subscription.

5. Perhaps the best thing to say is that of the entries in my card index more of those frequently looked up and used come from The Electrical Engineer than from any other American electrical paper.

LAWTON, MICH.—Geo. H. Rix & Company, who have a 25 years' franchise, will have eight miles of circuit and in addition to lighting will pump water, etc. The capital is $8,000.

MECHANICAL

THE WESTINGHOUSE GAS ENGINES.

RECOGNIZING the fact that in many situations gas engines can be operated to advantage, the Westinghouse Machine Company, of Pittsburg, Pa., have just brought out a complete line of these engines ranging from 5 to 500 h. p.

In its general design these engines embody the important features which have made the Westinghouse steam engine so popular and successful; the upright self-contained construction and the self-lubricating principle being particularly apparent.

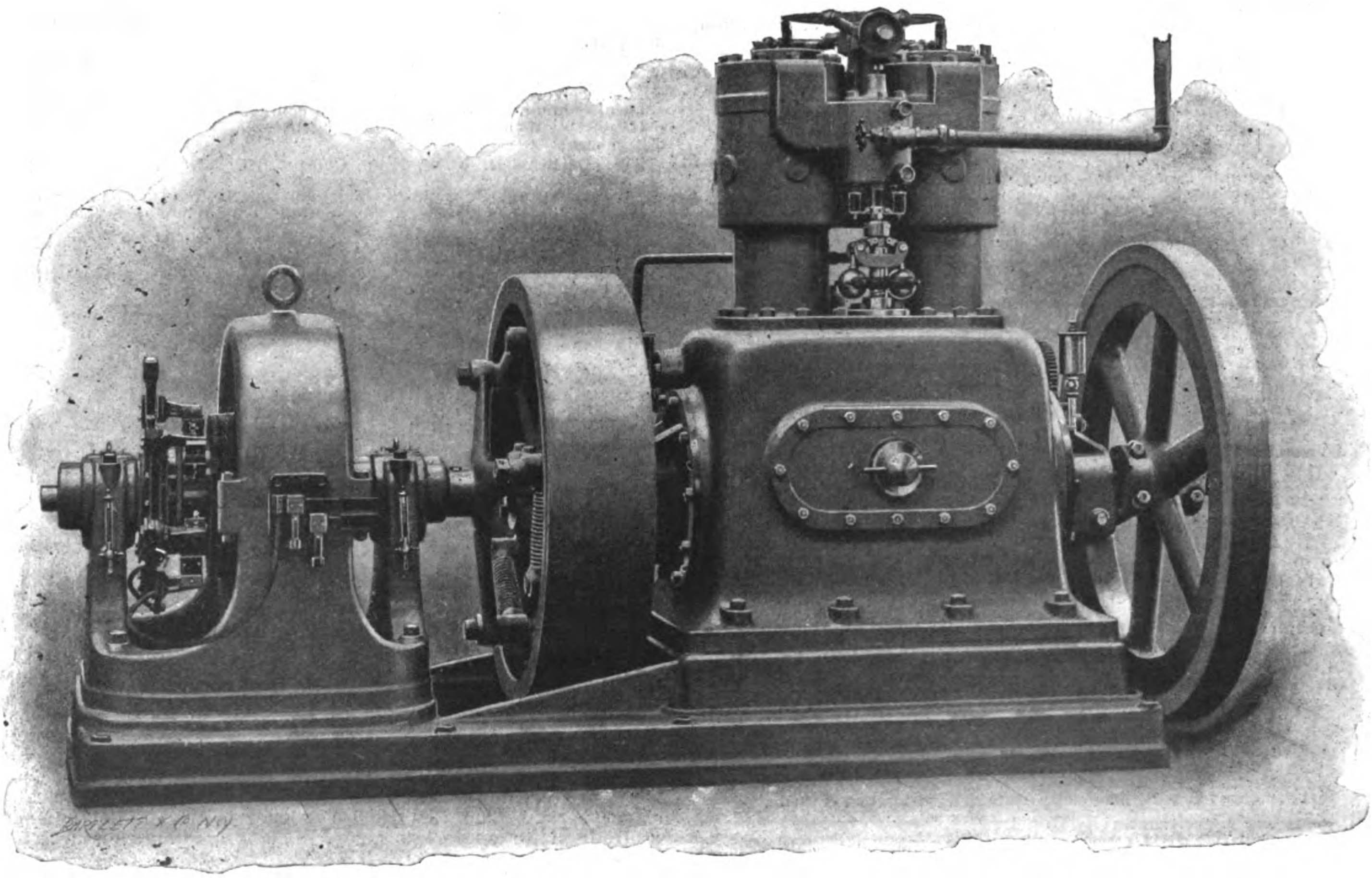
The cylinders, two in number on the smaller sizes and three on the larger sizes, are cast from a special mixture of hard, fine-grained iron, bored and finished with a high degree of accuracy. The pistons are of the trunk pattern, cast from the same quality of iron as the cylinders, made very long in order to serve the purpose of a cross-head, without causing perceptible wear on the cylinder walls. The piston is packed with cast-iron spring rings, which insures a maximum of tightness and long life. As in the Westinghouse steam engines, the piston carries a case-hardened steel wrist pin, accurately ground to size, with which the upper end of the connecting rod engages. The connecting rods are forged from steel, the ends being fitted with adjustable bronze boxes lined with the best quality of genuine babbitt metal. The adjustment of the piston end of the connecting rod, usually a difficult operation in trunk piston engines, has been taken care of in a particularly ingenious and convenient manner.

The shaft is a forging made from the best quality of open-hearth steel, the cranks being forged solid and slotted out; it is machined all over and is particularly strong and heavy.

The bearings are all adjustable, the lower halves being set up by wedges operated by screws. As the wear on the bearings is always downward, the upper halves preserve their original position. In taking up the wear, the wedges are drawn across until the shaft is brought up against the upper halves of the bearings.

The ignition of the explosive mixture is accomplished by the electric spark. The igniters are simple in construction and exceedingly durable. They are mounted in small castings, easily removed and replaced. In sizes from 15 h. p. up, there are double igniters in each cylinder. One igniter only in each cylinder is in operation at any one time, the other being held in reserve. In case of accident to the igniter in service, the battery wire can be instantly shifted to the binding post of the reserve igniter and the engine kept in service until it can conveniently be shut down for examination.

The lubrication of the main bearings is taken care of by sight feed oil cups, supplied with the regular Westinghouse crank case oil costing 15 cents per gallon at Pittsburg. The crank case is filled with water up to the division in the crank pin brasses, when the engine is on its bottom center, and a layer of crank case oil about one-half inch thick is added on top of the water. The motion of the cranks beats the oil and water into an emulsion, which is thrown over the internal working parts, lubricating them copiously and thoroughly. When the engine is once started, there is enough surplus oil from the main bearings passing into the crank case to keep up the supply. A gauge glass on the back of the crank case always indicates the proper height of the oil and water.



WESTINGHOUSE GAS ENGINE.

The governor and valve mechanism are lubricated by a small amount of any good quality of engine oil, fed by sight feed cups. No cylinder oil whatever is required. The piston coming in contact with the oil thrown against the lower end of the cylinder walls, carries up the small quantity of oil necessary to keep the pistons and cylinders in good condition.

With the engines which are too large to be readily started by hand there is furnished a simple and effective air compressor and an air storage tank of ample capacity. The air compressor can be operated by hand to charge the tank for the first time, after which it is run by a belt from any convenient pulley either on the engine itself or on the shafting. By running the compressor a few minutes every day the tank is kept fully charged and ready for starting the engine at any time. In starting, one cylinder of the engine is converted into a compressed air motor, without disturbing the functions of the other cylinder or cylinders. The engine being set with the crank a little past its upper center, the air and gas inlet valves properly adjusted, and the stop valve on the air tank opened, it starts up and continues to run on the air pressure until explosion takes place in the other cylinder. The stop valve is

then closed, the inlet and exhaust valves set again to work in the regular manner, and the engine is in full operation. Three or four revolutions with the air pressure are generally sufficient, the process being strictly automatic, requiring no manual dexterity on the part of the operator, and consuming less time than it takes to describe it. The Westinghouse gas engines, as do all gas engines which have achieved any marked degree of success, operate on the plan proposed by M. Beau de Rochas, popularly known as the Otto cycle.

By the use of two cylinders alternating the working strokes of the pistons, the Westinghouse gas engine receives an impulse at every revolution. A sensitive governor regulates the amount of the explosive mixture admitted for each charge, in proportion to the load on the engine, giving an impulse at every revolution whether running fully loaded or entirely light. On this account, for smooth running and steady speed, it is claimed to be equaled only by the best steam engines, and these essential and desirable qualities are obtained without overloading the shaft with heavy flywheels. The engine is therefore claimed to be specially suitable for electric lighting work.

For the Westinghouse gas engines there has been established a commercial rating which bears about the same relation to the ultimate brake horse power as the rated power of the steam engine bears to its ultimate capacity; that is to say, the rating represents about 80 to 85 per cent. of the total maximum brake horse power developed on the test. This enables the engine to take care of occasional overloads, to compensate for the various qualities of gas met with in practice, and does not compel the purchaser to forget all his settled ideas as to what constitutes a commercial horse-power in a motor of any sort.

MR. C. W. SPEAR has been appointed the receiver to wind up the affairs of the Swan Incandescent Electric Light Company, which is going out of business, with $6,903 assets and no liabilities.

TRADE NOTES & NOVELTIES

THE CONSOLIDATION OF A. K. WARREN & CO. AND THE ELECTRICAL MAINTENANCE CO.

We have to report the union of two well known industries, viz., that of A. K. Warren & Co., of 451-453 Greenwich street, New York City, the old-established emergency and repair house of New York and the surrounding districts, and the Electrical Maintenance Company, late of 50 Broadway.

The consolidation of the two interests into one business has formed a substantial concern, with branches in Boston, Philadelphia, and Baltimore, so that in conjunction with the large trade which was heretofore profitably enjoyed by A. K. Warren & Co., it is now augmented by between five and six hundred maintenance contracts, transferred by the Electrical Maintenance Company on consolidation.

VIEW IN ARMATURE WINDING DEPARTMENT, SHOPS OF AMERICAN ELECTRICAL MAINTENANCE CO.

It was wisely decided by the various heads of the two companies interested that a change of name would be beneficial, and they decided upon calling the consolidated concerns "The American Electrical and Maintenance Company," retaining as a trade-mark the well known white Swiss cross adopted by the former firm some years ago.

The field of the business established by these two companies covers maintenance by contract, repairs in general and emergency work in particular, and wiring supplies of every description, so that after the contractor has installed a plant, wheresoever it may be, the only way the proprietor can guarantee a certain expense per annum is by taking a contract to cover all losses by damage, both large and small, to his electrical machinery. The importance of this is demonstrated by the number of contracts that have been written in-

dividually by these two concerns in different branches in the past two years, the field being thoroughly worked by an efficient corps of agents. The results have proved the establishment of an entirely new business in the electrical field.

With the extensive repair shops that this concern now have they are able to undertake repairs to any style, class or size of machine used, and with their branches throughout the United States, they will be able hereafter to minimize the expense of running an electric plant and the danger of its shutting down at times (as is often the case) when it is most needed. The shops are open day and night, and are at the call of all users of electricity, either for light or for power, and a large force of expert electricians and mechanics is at instant call for those who need them.

The directors and stockholders of the American Electrical and Maintenance Company are men well known in the electrical business. The engineering department of this company is under the superintendence of Mr. A. K. Warren, whose ability and indefatigable zeal in emergency matters are well known to most of the electric light stations and isolated plants within one hundred miles of the "Empire City." The financial part of the business is conducted by Mr. James Rich Steers, formerly Mr. Warren's partner in the firm of A. K. Warren & Co., and the entire general management of the enterprise is in the hands of Mr. George Stanmore, late general manager of the same firm.

The board of directors comprises the following well known, substantial gentlemen: A. K. Warren, E. R. Johnes, G. Harvey Cook, Henry B. Wilson, William Duryea, J. R. Steers and George Stanmore, New York; Henry A. Root and G. Arthur Hilton, Boston.

The home office of this undertaking is 451-453 Greenwich street, New York City, and the facilities for handling their class of work are amply exemplified in the illustrations in the new catalogue issued by this company, which will be sent free for the asking.

The executive officers court inquiry and investigation of all their methods and means for taking charge of plants or arranging for immediate repairs on all classes of mechanical or electrical appliances.

In addition to the above they are arranging a system for the exchange or handling of second-hand apparatus, which at the present time it is difficult to obtain except by costly advertising and personal investigation, and the methods employed will give the purchasers or parties wishing to sell different styles of apparatus facilities for transacting the sale or purchase at far less than heretofore.

It may be well to mention that this business was started about five yeas ago, with a small shop employing about five men. It has now a pay roll list of about one hundred and twenty men on repair and emergency work alone, thus showing the rapid growth and the public's appreciation of an industry that becomes yearly more a necessity owing to the general use of electricity.

CENTRAL ELECTRIC CO.

The Central Electric Company, of Chicago, feel that there is nothing more inspiring than to be congratulated by their patrons, upon satisfactory material, and pleasing shipments. They state that they are constantly receiving congratulatory letters and verbal approbations from their numerous friends and customers. As evidence of the success with which their railway materials are meeting, the following is quoted, as having been received from one of their best customers, which is direct evidence of their faculties for pleasing:

"Central Electric Company, Chicago, Ill.

Gentlemen:—

We have just completed eighteen (18) miles of electric railway, using your material for the entire overhead construction. We have found everything to be first-class and can recommend your materials for the purposes for which we used them. The shipments have all been made very promptly.

Yours truly,

President and General Manager."

ADVERTISERS' HINTS

THE MONSON-BURMAH SLATE COMPANY, Portland, Me., are making a specialty of slate for electrical work, both plain and ebonized, for switchboards, etc. Many leading manufacturers after using specimens of the slate are now continuing it in preference to any other.

THE GENERAL ELECTRIC COMPANY illustrate the "Type H" transformer of which they are building a complete line with capacities varying from 600 to 30,000 watts, and also publish a table showing the satisfactory results obtained by their use.

THE C & C ELECTRIC COMPANY, 143 Liberty street, New York, have appointed Messrs. Sargent & Lundy, Monadnock Building, as their general sales agents in Chicago. Messrs. Sheehan and Hewitt, 14 South Water street, Newburg, N. Y., will take care of their interests in central, northern and western New York.

WALLACE BARNES, Bristol, Conn., supplies springs of every description for use in the construction of machinery and instruments.

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Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXIV. JULY 29, 1897. No. 482.

ELECTRIC LIGHTING

MOORE LATEST VACUUM TUBE LIGHTING APPARATUS.

WHEN Mr. D. McFarlan Moore, after a long period of study, came to the conclusion several years ago that the solution of the vacuum tube lighting problem lay in breaking an inductive circuit in a vacuum, he almost immediately decided that it could be done most advantageously by the use of a rotary motion—not a vibratory motion. But he also realized that mechanically a vibratory motion was far easier to construct in a vacuum than a rotary one and that the vibratory motion in the form of his vacuum vibrators would have a large field of usefulness and, since immediate results were very much desired, he decided to demonstrate the feasibility and practicability of the vacuum break by means of the vibrator, and he therefore perfected that device first.

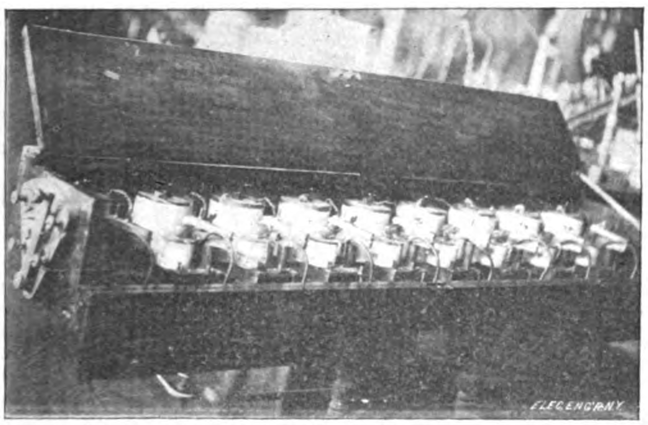
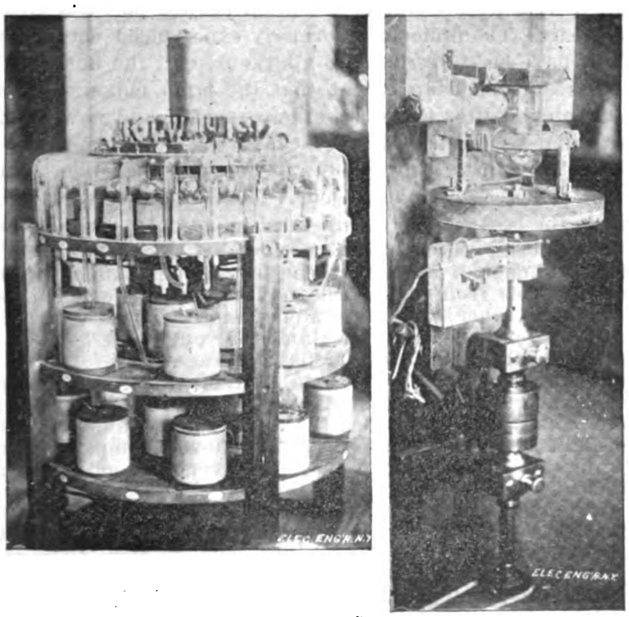


FIG. 1.—MOORE VIBRATORS.



FIGS. 2 AND 3.

The accompanying illustrations show the various stages of his apparatus due to this decision. Fig. 1 shows one of the three boxes 4 feet 6 inches by 14 inches by 10 inches, which contained nine vibrators each and which were used by Mr. Moore in lighting the hall of the American Institute of Electrical Engineers, the first hall in the world to be so lighted. Our readers will also recall Mr. Moore's lighting the stage on the occasion of his lecture before the N. E. L. A., and, finally, his exhibit at the Electrical Exposition in New York, during May, 1896, at the Grand Central Palace, which was viewed by 85,000 people.

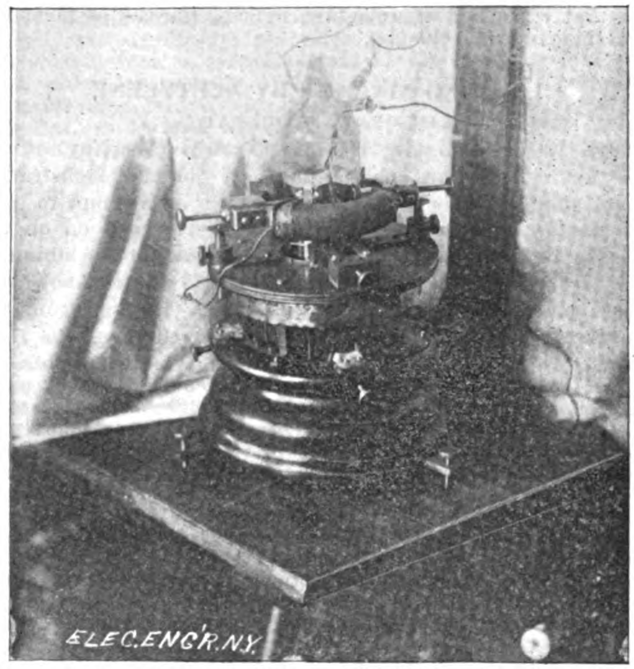


FIG. 4.—MOORE ROTATOR VACUUM BREAK.

Fig. 2 shows the next piece of apparatus constructed by Moore, in which the vibrators are arranged in the form of a cylinder instead of in long boxes. This piece of apparatus lighted the entire Moore laboratory for several months last fall. Fig. 3 shows one of the early forms of rotators, which was also used to light the laboratory.

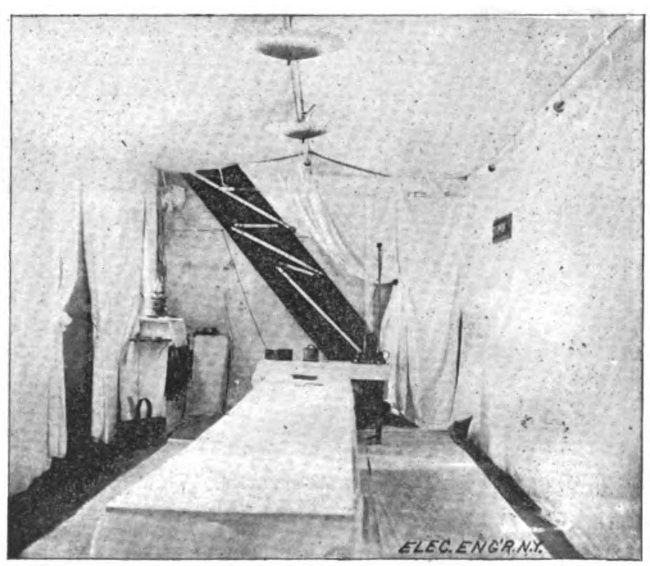


FIG. 5.—ROOM LIGHTED BY MOORE VACUUM TUBES.

Fig. 4 shows a beautiful piece of apparatus, the finished rotator which was used to light the hall at the Moore laboratory during the entire evening of his last exhibit, on May 27, 1897.

Seventy-five people sat in a room 11½ by 34 feet under the perfectly steady rays of vacuum tubes for two and one-half hours, and were there photographed. Fig. 5 shows the interior of the room. It will be noticed that the tubes are hung near the junction of the ceiling and wall at about the place usually occupied by a picture moulding.

By way of diversion Mr. Moore entertained his visitors by showing them a number of interesting experiments. A lightning flash and giant candlestick are shown in the illustration, as well as one of the signs on the wall.

Mr. Moore informs us that it will not be long before he will be able to show still further advances of a pronounced character, that will place vacuum tube lighting abreast of incandescent lighting, in economy.

LIGHTING NIAGARA BY ACETYLENE.

BY ORRIN E. DUNLAP.

THE Acetylene Light, Heat and Power Company, of Niagara Falls, are making the first public demonstration of the illuminating powers of their gas in an attempt to light the great cataract. The lights were first turned on on the evening of Thursday, July 16. For the present the illumination is confined to the American Fall and the rapids of the upper river above and below the bridge leading from the mainland to Bath Island, generally referred to as the Goat Island bridge. In all, fifteen large locomotive headlights are in use, and eleven of them have seven burners each, while the remaining four have five burners. These burners are of the Naphey pattern, and consume one-half foot an hour.

Six headlights have been placed on the Goat Island bridge, three on the upper and three on the lower side, while others have been placed in Prospect Park, and four below the high bank on the debris slope. The lamps on the upper side of the Goat Island bridge throw their beams on the water as it comes tumbling down from reef to reef, and the lights on the lower side gleam across the dancing waters as they speed onward toward the brink of the American Fall, their plunge over the magnificent precipice being illuminated by the lights in Prospect Park. As the waters tumble on the rocks below and send up a spray cloud the beams of the lights below pierce the mist and make a beautiful sight.

The expanse of the river just above and at the brink of the American Fall is very great, and this extent of space makes the lights appear as having no great penetrating powers, whereas the fact is that they are quite strong, but the apparatus in which they are fitted is hardly the thing to show them off in all their brilliancy. Then, again, the plant was installed with considerable haste, in order that it might be in operation on the occasion of the recent visit of the Pan-Americans. One thing fully made clear by the demonstration is that

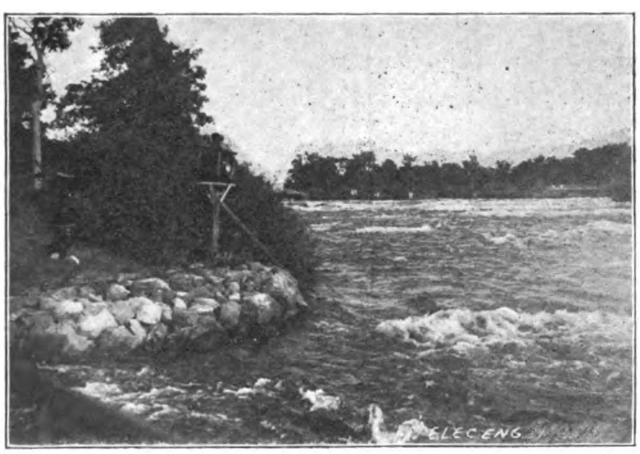


FIG. 1.—LIGHTING NIAGARA BY ACETYLENE. VIEW OF THE RIVER FROM PROSPECT POINT.

Manager Devine, of the Acetylene Light, Heat and Power Company, is a hustler of no small degree, for he had the entire equipment installed in a very few days.

The gas is supplied to the lights from three Naphey automatic generators, each of 250 pounds' capacity. One of these generators is placed in the inclined railway building adjoining Superintendent Welch's office; another in what is known as the lower park office, and the third in a small building on Bath Island. From the generators half-inch pipe runs to the lights, and a large amount of this pipe was necessarily laid, the Oliver Company having the contract. All the pipe is carefully concealed beneath the sod or under the bridge.

This is not the first time the falls have been illuminated. In 1879, when electric lights were somewhat of a novelty, the park was owned by a private company who had the enterprise to purchase a Brush generator to supply eighteen lights, but after a few nights' trial it was found that its capacity was not large enough, and the company exchanged their generator for one of larger capacity. With this outfit the Falls,

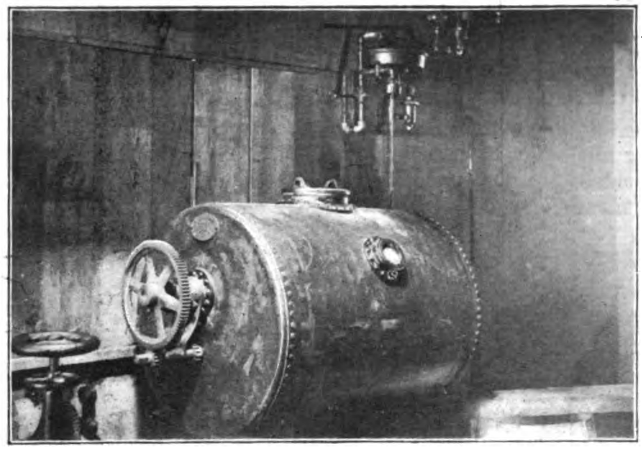


FIG. 2.—THE ACETYLENE GENERATOR.

park and gorge were nicely lighted, and in one summer over 150 excursions came to the Falls at night to see the illumination. Every night the park was crowded, and not the least beautiful effect was the light thrown on the fountains through colored glass. When the State of New York took the park and opened it free to all mankind forever, the electric light plant was sold, and since then the great cataract has been shrouded in the darkness of night, much to the regret of the residents and visitors, for Niagara at its best is lacking in evening attractions, and the lights on the Falls served to aid in passing the evening. For this reason the acetylene illumination will be popular with all.

"220 VOLT LAMPS."[1]

By PROF. G. D. SHEPARDSON.

THE high voltage incandescent lamp has been attracting an increasing amount of attention during the past four or five years. The difficulties formerly experienced with 220-volt lamps have been overcome to a large extent; the business has increased to such an extent that the lamp makers can sort their lamps better to supply orders exactly, and now the 220-volt lamp seems to be in the field to stay. Reports from the plants are almost invariably encouraging, whether coming from manager or from patrons. Their common verdict that this is the best system extant must be accepted as proof positive of good, reliable service and of a good reputation at home, although it must be borne in mind that much of their praise comes from those who have had little or no experience with other modern systems and who also naturally stand up for home industries and for "our plant." Even the reports from engineers who have changed from 110 to 220 volts must be taken with some caution. For example, from one of the large English plants that has recently changed over, comes the report that the new 220-volt lamps give better light with less watts than the 110-volt lamps displaced. But by test the 110-volt lamps were of very low efficiency, and old at that.

The advantages of using higher voltages are well understood by engineers. It is commonly understood that 125-volt systems cannot economically serve districts more than about 1,000 feet distant. For larger districts the three-wire and alternating systems have had the field to themselves. But the low, all-day efficiency of the alternating system, when used for scattered lighting, and the exclusive control claimed over the three-wire system, have driven the independent manufacturers to the high voltage lamp as the only practical means of competing for such business. The 220-volt lamp has been so successful for lighting villages and small cities that the

[1]Read before the Northwestern Electrical Assoc.—Abstract.

alternating system seems to have given way and almost all of the new plants in such places now adopt the 220-volt direct current system, where a few years ago alternating systems had the field almost to themselves. The companies using the three-wire systems also find in the 220-volt lamp the possibility of extending their lines to outlying districts and of operating motors at 440 volts directly from the outside mains of the lighting service, instead of requiring special 500-volt generators and power circuits.

It is urged against the 220-volt lamp that it is of lower efficiency than the 110-volt lamp, so that the power plant must be larger to supply an equal amount of light. The larger item of interest on first cost of power plant and larger fuel

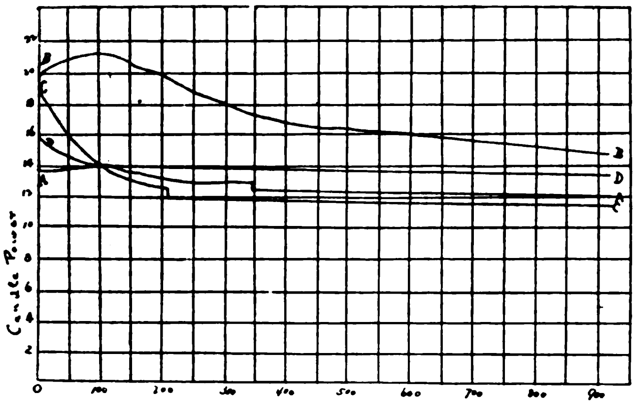


FIG. 1.

account may more than offset the saving in cost of copper if calculated for the same percentage loss. The 220-volt lamps also cost more than the 110-volt, but this is unimportant, since the first cost of an incandescent lamp is only a small fraction of the value of the current used during its lifetime. Again, the average life of the low efficiency 220-volt lamp seems to be longer than that of the higher efficiency 110-volt lamp, so that the cost of renewals may even be in favor of the 220-volt lamp. The economy of copper is even greater than indicated by the foregoing discussion.

Lamp makers advise the operation of lamps at high efficiency only when the regulation is close, and they advise low efficiency lamps for use where the voltage fluctuates considerably. The 220-volt lamp cannot be made with as high efficiency combined with reasonable life as can the 110-volt lamp of equal candle-power, on account of the smaller diameter and greater length of the filament. When operating at high efficiency, the temperature of the filament is higher and the filament is, therefore, softer, less rigid and mechanically weaker.

The necessarily lower efficiency of the higher voltage lamp is not an unmixed evil. For, since its efficiency is low, the allowable variation of voltage is greatly increased. Consequently, if two systems, one for 110 volts and one for 220, be laid out for equal percentage variation of voltage, the variation of the light from the 220-volt lamps will be hardly noticeable when that of the higher efficiency of 110-volt lamp will be intolerable. From this it follows further that if the two systems be laid out for equal fluctuation of light, the 220-volt system will allow much greater percentage range of voltage and require correspondingly less investment in copper. The conclusion is, therefore, reached that the 220-volt system requires considerably less than one-fourth the weight of copper required by the 110-volt system for serving the same district with equal satisfaction to users. When it is considered that the cost of the feeders and mains often equals or exceeds the entire cost of the station equipment, it appears that the great saving in copper easily balances the increased cost of the larger generating plant and of the larger amount of fuel.

In order to obtain accurate and reliable data concerning various 220-volt lamps on the market, new lamps were secured from the regular stock of several lighting plants in Minnesota, representing the regular output of three different manufacturers as furnished to regular customers. Samples were obtained directly from another manufacturer for test purposes. Lamps were ordered from a fifth factory, which claimed extraordinary results, but they declined to furnish the lamps ostensibly on the plea of being behind their orders owing to an unusual rush of business.

Arrangements were made for a life and efficiency test of the various lamps. By the courtesy of the Minneapolis General Electric Company, current at 220 volts was obtained from the outside mains of the Edison three-wire system. The city gas inspector allowed the use of his photometer room which was connected with the three-wire street mains at a point about 2,000 feet from the station and where the voltage fluctuated as much as at any part of the system. The measurements were made by O. G. F. Markhus and W. A. Myers, fourth year students in electrical engineering at the University of Minnesota. The results are exhibited in the accompanying curves, Figs. 1 and 2. The various makes of lamps are marked A, B, C and D. One lamp each of A and C groups was found to be very poor, while the others agreed quite closely.

The record of breakage is somewhat interesting. Twelve lamps of make marked D were obtained from the factory, six directly and six through an agent. Four broke in transit, two exploded as soon as connected into circuit. Of the two placed with globes horizontally, the one having the plane of the filament at base in the vertical position lasted throughout the life test, while with the one with plane of filament in the horizontal position the filament drooped in 159 hours so far as to touch the globe and crack it. The filament of the corresponding lamp of group C drooped and broke the globe in 215 hours. The corresponding lamp of group D broke in the same way in 315 hours. The anchor in the horizontal lamp of group A, having the plane of shank vertical, broke and allowed the filament to touch and break the globe after 345 hours. With these exceptions all the lamps were in fair condition at the end of 920 hours when the test closed. The conclusions seem to be that if the lamp is hung vertically it will last 1,000 hours or more if it lasts ten minutes. If the lamp must be placed horizontally, the shank of the filament should be vertical rather than horizontal. It is also suggested that the size of globes might be increased with advantage.

As a matter of general interest a new lamp of each group was subjected to a breaking test. The following table shows great variety both in the toughness of the filaments and also in the change of resistance:

Lamp.	Voltage.	Amperes.	Lamp Broke, Seconds.
A	316	1.05	31
B	300	.78	30
C	447	.85	40
D	378	1.10	31

The lamp tests here presented are offered not as an exhaustive research covering all suggested or possible problems connected with the performance of high voltage incandescent lamps, but simply as a modest contribution to the literature of the subject.

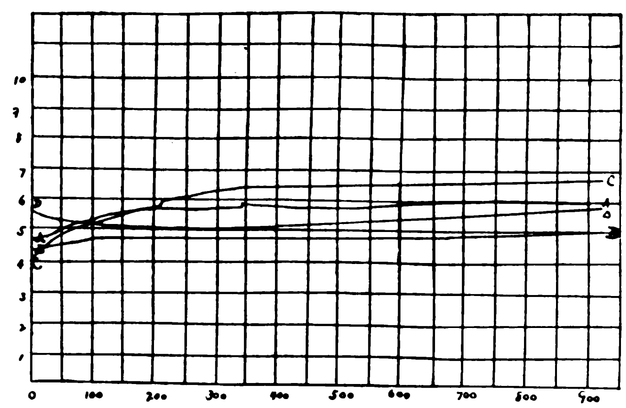


FIG. 2.

In closing, I will submit some reports recently obtained from a few of the 220-volt municipal plants in Minnesota, which were kindly placed at my disposal by W. I. Gray & Co., of Minneapolis.

Copy of reports received from 220-volt plants at Adrian, Wells, Lake City and Windom, Minn.

ADRIAN.—The electric light plant consists of an 80 h. p. high speed engine made by Ball Engine Company and a 55 k. w. dynamo made by Siemens & Halske Company. Plant has operated two years with entire satisfaction. Make of arc lamps used, Manhattan; make of incandescent lamps, Edison; average of incandescent lamp life, about 600 hours; number of arc lamps for street lighting, 12; number of arc lamps used for inside lighting, none; number of incandescent lights used in stores, 480 16 c. p.; number of incandescent lights used in residences, 110 16 c. p.; cost of incandescent lights, 16 c. p.,

per month, in stores, 45 cents; cost of 16 c. p. incandescent lamps in residences, per month, 45 cents, 10 o'clock circuit; 55 cents, 11 o'clock; 65 cents, 12 o'clock. How many hours a day does plant run at this season of the year (January, 1897)? Six hours. Meter rate to consumers, 8½ cents per 1,000 watts; income from the plant, per month, $185; expenses of operation, per month, $195; amount of (Youghiogheny) coal used last month, about 19 tons.

(Signed) G. A. SANDS, Recorder.

Water-works and electric lights operated from same plant at Adrian.

WELLS.—The electric light plant consists of an 80 h. p. engine made by Ball Engine Company, and a 50 k. w. dynamo made by the General Electric Company. The plant has operated two years with good satisfaction. Make of arc lamps used, Thomson, '93, and Manhattan; make of incandescent lamps used, Edison; average life of incandescent lamps, 600 hours; number of arc lamps used for street lighting, 6; number of arc lamps used for inside lighting, 16; number and candle-power of incandescent lights used for street lighting, 25; number of incandescent lamps used in stores and residences, 900 16 c. p.; cost of 16 c. p. lamp, per month, in stores, 50 cents, 10 o'clock; 12 o'clock, 65 cents; residence lights all on meters; meter rate to customers, 10 cents per 1,000 watt hours; average load, 125 amperes; largest load, 196 amperes; income from plant, per month, $300; average expenses, $300; amount of Wilmington coal used last month, 45 tons—February, 1897. (Signed) A. JOHNSON, Supt.

LAKE CITY, MINN.—The electric light plant at Lake City consists of a 125 h. p. Ball & Wood engine, a 40 k. w., 220-volt dynamo, made by the Commercial Electric Company, and one 75-light Excelsior arc dynamo. The plant has operated for one and one-half years with entire satisfaction. Make of incandescent lamps used, Edison; number of arc lamps on streets, 45; number of arc lamps for inside lighting, 11; number of incandescent lamps for inside lighting, stores and residences, 850; cost of 16 c. p. lamp, per month, in stores and residences, 40 cents, 9:30 o'clock; 50 cents, 11:30 o'clock; largest load in amperes, 115. How many hours per day does the plant run at this season of the year? Eight. Meter rate to consumers, 10 cents per 1,000 watt hours; income from plant, per month, $225. Dated March, 1897.

WINDOM, MINN.—The electric light plant at Windom, Minn., consists of an 80 h. p. high speed engine, made by A. L. Ide & Son, and a 60 k. w., 220-volt dynamo, made by the Western Electric Company. The plant has operated one year with good satisfaction. Make of arc lamp used, Western Electric Company; make of incandescent lamps, Edison; average life of incandescent lamps, 400 hours; number of arc lamps used for street lighting, 4; number of arc lamps used for inside lighting, 18 Manhattan; number of incandescent lamps used for street lighting, 40; number of incandescent lamps used in stores and residences, 700; cost of one 16 c. p. incandescent lamp, per month, 4 and over, 45 cents; average load in amperes, 150; largest load, 210 amperes; meter rate to customers, 10 cents per 1,000 watt hours; income from plant, per month, $225; expenses of operation, per month, $165; amount of coal used last month, 38 tons—February, 1897.

(Signed) A. WOOLSON, Supt.

The above are all municipal plants owned and operated by the cities.

ELECTRIC METERING FROM THE STATION STANDPOINT.[1]—I.

BY CARYL D. HASKINS.

It is a well established fact to-day, well borne out by data from widely separated portions of the country, that the average electric lighting station can do one-third more business with the same station capacity on a meter basis, than it could upon a contract basis, under what were nominally equivalent contract rates, netting at the same time the same revenue per light as formerly. In other words, it is apparently well established that 33⅓ per cent. represents the average wastefulness of average human nature in connection with the use of light.

In response to an inquiry as to what merits in a meter are necessary to success, a common reply is, accuracy, durability, registration in a simple unit easily comprehended by the customer, and ability to withstand tampering. These points are probably of importance in about the sequence in which they are commonly stated; but they are too sweeping, too entirely generic and too slightly specific to be in any high degree helpful.

Let us, for example, consider the broad question of accuracy. A meter, which will be accurate under commercial conditions from quarter load to full load within 1-10th of 1 per cent., or a meter which will start on 1 per cent. of its rated capacity, are neither of them necessarily either the most accurate or the best for general commercial use. I am perfectly safe in saying, that a meter which will run within 5 per cent. of zero error on 5 per cent. of its rated capacity may readily be a much better meter, even though it will not run at all on 1 per cent. of its rated capacity, than one which will run on 1 per cent. of its rated capacity, but in regard to which no evidence is at hand as to its percentage of accuracy at reasonably low loads.

In considering the question of accuracy, therefore, the first two steps should be to determine the accuracy of the meter by actual measurements at full and medium load; and also at a reasonably low load; say, for example, 5 per cent. of the meter's rating.

One point which is very commonly neglected, but which is, nevertheless, quite essential, is the ability of a meter to give accurate results for brief periods on overloads. This is a point at which many meters fail, and is also a point which, odd as it may seem, is intimately related to light load accuracy. It may be laid down as a rule that in station operation the smallest meter which will do the work should always be used. Otherwise, however good the meter on light loads, much of the light load revenue must be lost in the effort to take care of occasional heavy loads. Extremely heavy loads are generally of brief duration, and on these loads a meter should operate with accuracy and also without injury to itself. This, therefore, should be an early point of investigation in selecting a meter.

On alternating circuits, inductive loads are becoming commoner every day. The wider use of fan motors and other alternating power devices, the rapidly growing popularity of alternating circuit arc lamps, and the commoner use of inductive dimmers, all render it essential that a meter should be accurate irrespective of the power factor. The company which insists upon charging its patrons for power delivered to fan motors on a basis of volt amperes, is obviously rendering itself unpopular, greatly limiting its business and giving its competitor, or competitors, the best of opportunity for intruding; yet, many such companies exist to-day, and they exist not because they are following a wise policy in their own estimation, but because they are ignorant of what they should look for in the meter which they are using.

Again, there are few electric light stations to-day of any considerable size and age which are not operating some smooth core and some tooth core alternating armatures. It is, therefore, important that the meters in service at such stations should be equally accurate on any shape of wave. This same consideration holds good in connection with frequency.

Even after this long list of points which must be investigated, as contributing to the broad question of accuracy, there are others which also merit consideration, but to a less degree. Such, for example, as barometric conditions (more especially altitude), temperature and humidity. These all have direct bearing upon the question and all enter into the every day conditions of central station practice.

The second point, which is commonly given consideration in the selection of a meter, is that of life. This is a question which must depend more upon good judgment than upon any test which can be applied..

Ninety per cent. of all the wear in a meter, centers in the case of motor meters at the single jewel bearing, which is almost universal. The two chief factors which have influence upon the mere mechanical life are the weight of the moving mechanism, and its speed, the variation of the area of the point of contact being, of course, always so small as to be out of the consideration.

Practice has indicated that low speed is more conducive to long life than is light weight of the moving mechanism, although both are, of course, very important. More important than either, however, is the quality of the material used at the points of friction and the ease with which the friction parts can be renewed. The best of sapphire is barely good enough, and the pivot end must be of correct shape, burnished to the highest degree, and its point must be absolutely concentric with the center of movement.

More than half of the meter jewels which are destroyed are rendered useless, not by the rotary motion of the shaft, but by reciprocating motion of the shaft, due to vibration. Hence it is very necessary that the jewels should be in some way cushioned, for vibration cannot be always avoided.

[1]Read before the Amer. Inst. Elec. Engrs. Abstract.

A NEW FORM OF INDUCTION COIL.[1]

BY ELIHU THOMSON.

THE induction coil presently to be described, it is believed constitutes a new type employing the principle of a "substitute primary" or "secondary primary," which principle has been applied by me in a variety of ways.

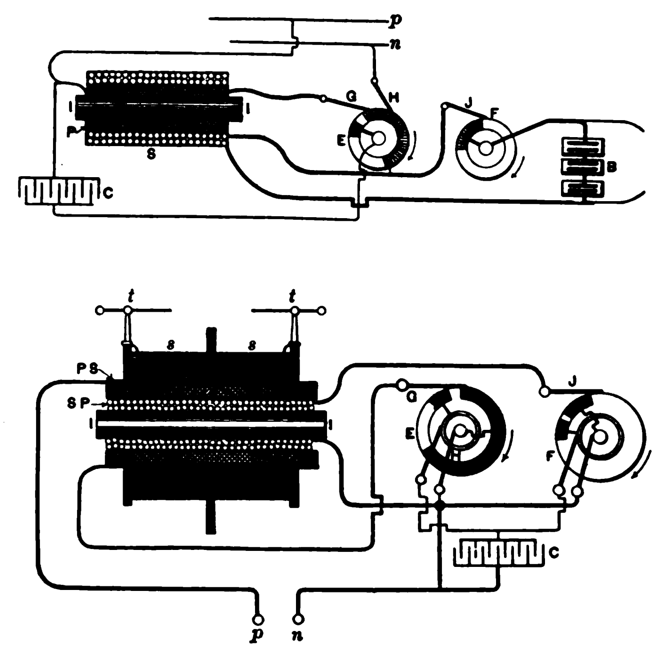
The prime object of this coil is to permit the direct connection to circuits of considerable potential for obtaining energy for the production of high potential discharges, like those of a Ruhmkorff coil for working Röntgen ray vacuum tubes, and for such like purposes. The object, also, was to avoid the employment of banks of lamps or storage batteries, and to limit the energy consumed to only that amount required to work the coil itself. Furthermore, no larger condensers than those ordinarily used with an induction coil of equal capacity are needed, and no air blast, while the coil as a whole is still available as an ordinary Ruhmkorff without change in its structure or connections.

To illustrate the principle, reference is made to Fig. 1, where p n represent connections to mains at, say, 110 volts difference of potential; I I is an iron wire core around which are wound two coils, one over the other, either of which may, of course, be the primary. The inner coil, P, in the figure is made the primary, and is wound with many turns of comparatively fine wire. For 110 volts it may have some thousands of turns and be wound with a wire safe for .5 to .75 ampere. The outside wire, S, may be coarse or fine. In the figure it is quite coarse and of relatively few turns, since it is assumed to give low potential and large current. The coil, S, is so proportioned as to be practically almost short-circuited at intervals by its load at B, which is three cells of storage battery in series, for example. The object is assumed to be that the batteries are charged by transference of energy from coil, P, to S at low potential in S. The coil, S, should have ample copper so as to lower its internal resistance as much as possible; the resistance of the cells, B, should be low; and the average voltage of discharge of S much superior to the counter e. m. f. of B. Two synchronously revolving break-pieces, E, F, which may, in fact, be combined into one, are used; E is for governing the intervals of passage of current in coil, P, and connection of condenser, C, across the break or interruption periodically made between one terminal of P by a brush, G, and a metallic segment on E occupying a considerable arc on its periphery. Brush, H, connects to main, n. Back of the main segment on E is a small condenser segment in continuous connection with one side or foil of the condenser, and the other side is connected to the other terminal of P, or that leading direct from line, p. The contact maker and breaker, F, has a segment which is in continuous connection with one terminal of battery, B, to be charged and which touches a stationary brush, J, at or about the time of the break between brush, G, on the main segment of E. The battery, B, may have terminals by which it may furnish current while being charged.

Now let the break wheels, E and F, be given rapid revolution, say, 10, 20 or 30 per second. The contact of brushes, G and H, with the main segment of E passes current for a certain considerable fraction of the revolution, at full line potential of 110 volts, through primary, P. The current rises gradually during this period, and may at the end attain a value of one ampere, more or less. With slow revolution it would be limited by the resistance of P chiefly, but at rapid rates, the time constant of P acting as a self-induction, determines the ultimate value of current before breaking. Upon the break of brush, G, with the main segment, it touches the condenser segment which is thereby put across the break, but the circuit of S is also closed by contact of segment on F with brush, J. The condenser receives only a small charge on account of the circuit of S having been closed. In fact, the break at G with main segment of E would be nearly sparkless without the condenser, C, but what slight self-induction is not wiped out by the mutual induction of the currents in S and P is very easily taken care of.

The magnetizing of the core, I I, or absorption of energy is by P, while delivery of energy is by S acting as if nearly on a closed circuit. This condition, however, does not involve much waste of energy if the ohmic resistance of the circuit of S be low enough. Here, then, is a transfer of energy from one circuit to another while the currents are direct currents in each circuit. To insure this being the case in S, the time of contact of segment on F with brush, J, must be selected so as not to permit any reversal, i. e., the break of said segment with K must be timed to be made on the cessation of the first impulse or discharge from S. To do this an ammeter, responding to direct currents only, placed in the battery circuit, or in the leads from S, will indicate a maximum direct current when the segment, F, is of proper extent, and less under other conditions.

With the principles of the above apparatus in mind, it is easy to understand the action of my new form of induction coil, which may be described, briefly, as follows. The iron core, I, Fig. 2, of the induction coil, is wound with the ordinary coarse primary coil and terminals provided therefor. Then a coil of intermediate gauge, between the inner primary and the outer secondary, is wound. It is to be capable of being connected across a circuit of 110 volts as with coil, P, Fig. 1. This coil is the true primary or energy supplying coil, but for convenience and saving of wire I prefer to connect it in as the under portion of the real secondary circuit. It thus becomes useful as a part of the secondary itself and having several thousand turns, adds a considerable fraction to the total potential of the secondary. The secondary is ,as



FIGS. 1 AND 2.

usual, of quite fine wire of many thousands of turns, well insulated throughout.

In Fig. 2, the coarse coil is marked S P, and the intermediate coil, P S, while that outside is marked S. The functions of the coils, S P and P S, are to act as secondaries and primaries alternately. This is, in fact, an essential function of S P, but is only incidental to coil, PS, having been connected into the secondary circuit, S, whose terminals are at t t. The break-wheels, E F, are like those of Fig. 1, except that in F there is a much shorter main segment and a condenser segment following, as in E. There is no battery in the circuit of S P, but it is put on dead short circuit at intervals, just at the time P S is broken. Coil, P S, receives current from line at p n, at 100 to 200 volts, or more. On the break of this circuit at brush, G, the ampere turns, so to speak, are shifted suddenly into circuit of S P, closed on itself by J F. The consequence is that even at slow breaks no spark occurs at the rupture of G E. As soon as the current has been fully established in S P on short circuit, and after brush, Q, has got entirely away from all metallic connections on E, the main segment of F breaks the circuit of S P which is conveying a very heavy current at low potential. The condenser, C, is put instantly across the break, and the spark flies between terminals, t t. In this way a coil of the size of a 6-inch Ruhmkorff, gives a torrent of 6-inch sparks with an average current from a 110-volt line of about one-half an ampere. A simple motor or clockwork may be used to drive the break-wheels, E F, which are made of fair diameter to insure accuracy in operation. The best results are only to be

[1]Read before the Amer. Inst. Elec. Engrs.

obtained when the proportioning of the parts is carefully done, and with a knowledge of the result to be obtained.

The discharges are indistinguishable from those of a similar Ruhmkorff. In fact, the coil described might be used with the same condenser, C, as an ordinary Ruhmkorff coil energized by batteries. In this case the terminals of the coil section, P S, are disconnected, brush, J, lifted and battery inserted between brush, G, and terminal of S P, which goes to J in Fig. 2. The break-wheel, E or F, when run with low potentials may be immersed in water in the usual way to facilitate sharp breaks, but the apparatus has been very successfully run, at full output, dry, or a little heavy oil on the break suffices. Also, the flux of current in S P, may be made by a magnet to break its own circuit under water when the current has risen to a predetermined amount. In other words, it may be provided with the usual automatic break, damped or adjusted not to get into tremulous vibration. It will be seen from the above description that a new way of energizing an induction coil, or other transforming apparatus, has been embodied and that it consists in the rapid substitution of secondary and primary functions in the coil, S P.

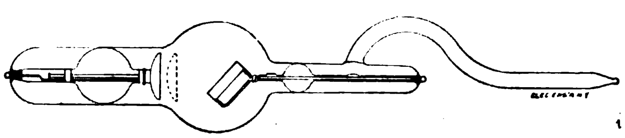
AN IMPROVED ADJUSTABLE X-RAY TUBE.

BY A. A. C. SWINTON.

FURTHER experiment has enabled the writer to design an improved form of adjustable X-ray focus tube which has considerable advantages over the adjustable tubes he has previously described.

The new tube is more easily and cheaply constructed than the multiple cathode tube previously illustrated,[1] while it is also more quickly and readily adjusted. Further, it has a much greater range of adjustment than the movable anti-cathode form of tube, and has the advantage that in adjusting it the position of the anti-cathode, and, therefore, the point of origin of the X-rays is not interfered with.

As will be seen from the illustration, the essential feature of the new tube consists in mounting the cathode upon a steel rod sliding in two aluminum guides, supported in a glass tube,



SWINTON'S IMPROVED X-RAY TUBE.

and connected by an aluminum wire to the cathode terminal. The arrangement is such that by using the tube in a horizontal position, and by simply tapping it at one end or the other, the cathode can be moved to a small extent in and out of tubular neck blown on one end of glass bulb. In this way the position of the cathode can be altered without moving either the tube or the point of origin of the X-rays on the anti-cathode. The exact position of the cathode relative to the glass walls of the tubular neck and bulb, is found to have an enormous effect upon the penetrative value of the X-rays produced. With a suitable and constant degree of exhaustion, if the cathode is placed as shown in full lines in the illustration, X-rays of very high penetrative value are produced, while the small movement of the cathode of about 0.3 inch toward the interior of the bulb required to place it in the position indicated by the dotted lines will suffice to reduce the penetrative value of the rays almost to zero.

Between these two extremes every grade of penetrative value is readily obtained by simply altering the position of the cathode between its limits of travel.

The effect is evidently due to changes in the electrical resistance of the tube, which, as measured by the alternative spark in air, is much highest when the cathode is in the position shown in full lines, i. e., that which gives rays of the greatest penetration, and appears to be closely connected with the distance between the edge of the cathode and the glass which is least in the position just mentioned. This factor is evidently so important that it much more than neutralizes the effect of the alteration to the distance between cathode and anti-cathode, which, as the writer has previously shown, has the result of increasing the penetrative value of the rays, and also the resistance of the tube the nearer these two electrodes are together.

In the tube illustrated the anti-cathode is made of a thick disc of aluminum faced with platinum, in the manner previously described by the writer. This arrangement is found to be very advantageous for tubes destined to be worked with considerable electrical power, say, the full force of a 10-inch Ruhmkorff coil.

Where smaller induction coils are employed, the ordinary form of anti-cathode may be used, but in this case, also, the aluminum-backed arrangement will be found advantageous in that its employment greatly conduces to the permanent maintenance of a constant degree of vacuum.

[1] See The Electrical Engineer, May 12, 1897.

ELECTRIC TRANSPORTATION

ELECTRIC TRACTION, WITH ILLUSTRATIONS FROM THE PRACTICE OF THE METROPOLITAN ELEVATED OF CHICAGO.[1]

BY M. H. GERRY, JR.

WITH a given number of stops per mile, the amount of power required, will increase very rapidly with the speed beyond a certain point, and the cost per car mile will not furnish a reliable basis of comparison for the motive power of different roads unless the conditions are the same. A slight difference in the average speed, or in distance between stations may cause a considerable change in the amount of power required.

Certain operating conditions have a special bearing on the efficiency of this form of motive power; the most important being the frequency of the train service. If traffic is such that a large number of trains must be operated on a division, the electric power will have an advantage in point of economy, over steam locomotives; and if the trains are few, the reverse will be the case. This condition holds good independently of the weight of the trains or of the speed attained. The length of the line is in itself no bar to the successful operation of an electric railway system, as, by using alternating current apparatus, the power stations may be located favorably, and at long distances apart.

The Metropolitan Elevated Railroad, Chicago.—This system, now in its second year of operation, is the largest road in existence employing exclusively electric power for a heavy passenger service. The structure has four tracks, from Market street west to Marshfield avenue, at which point three double track lines diverge. The northerly branch divides again near Robey street into two double track branches. From Market street to each of the terminals, the distance is about six miles.

Current is conveyed to the trains by the third-rail system; the "trolley rail" being placed 20⅛ inches outside and 6¼ inches above the running rail. It is of the common "T" section, bonded with leaf copper bonds, and divided into sections to provide for expansion. The insulation for the third rail, on all but a small section of the road, consists of hardwood blocks, mounted on small iron chairs fastened to the ties. On a recent extension an improved form of insulation made of stoneware has been tried with success. The electric leakage is small at all times.

The rolling stock consists of motor cars, passenger cars and a few coal and flat cars. The motor cars measure 47 feet in length and weigh about 62,000 pounds when loaded to their maximum capacity. They are mounted on rigid bolster locomotive type trucks, having 33-inch steel-tired wheels. The truck centers are 33 feet 6 inches apart and the truck wheel base 5 feet 6 inches. One truck of each motor car is equipped with two motors, each nominally rated at 2,000 pounds drawbar pull.

The air-brakes are of the direct or "straight" air type with an additional re-enforce cylinder. The air is compressed to 60 pounds by a vertical pump, driven by a motor of about 3 horse-power.

The passenger cars are 47 feet in length and of the standard pattern, in use on all elevated roads. They are mounted on swinging bolster trucks, having 30-inch wheels and when loaded to maximum capacity weigh about 46,000 pounds.

The Power Absorbed by Trains.—In an electric railway system, the mechanical energy supplied at the engine shaft may be divided for purposes of discussion into two general classes. First, that finally absorbed or utilized in propelling the train, and secondly, the energy lost in transformation and transmission, including losses in generators, line rheostats and motors.

[1] Abstract of paper read before the Amer. Inst. Elec. Engrs.

The first division or class, that is, the energy to propel a railway train, may be divided again into three parts: First, that required to overcome inertia and accelerate the train to its maximum speed after each stop. Secondly, the energy required on account of ascending grades. Thirdly, that required to overcome train resistance; including friction, air resistance, etc. If the stations are far apart, the energy required to accelerate the train may be neglected without serious error, but for a service where trains make frequent stops, and the maximum speed is high, compared with the mean speed, it becomes of importance, and may easily be the greatest of all losses.

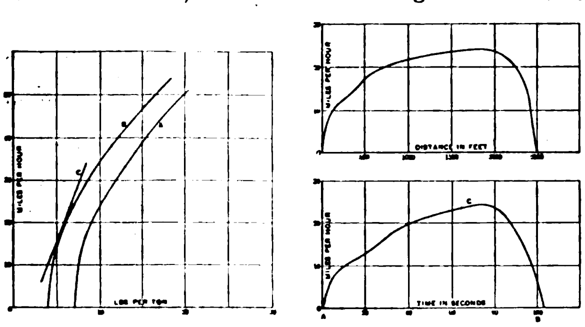
The work done in ascending grades is the product of the

No. of trip	1	2	3	4	5	6	7	8
No. of cars in train	4	4	4	3	3	2	2	4
Total time of trip	28'26"	29'03"	28'30"	28'37"	27'26"	25'30"	23'48"	32'44"
Total time of stops	2–19	2–05	2–42	1–47	1–16	0–54	1–22	1–41
Time running	26–07	26–58	25–58	26–90	26–10	24–36	22–26	31–03
Average speed (including stops)	13.3	13.0	13.2	13.88	14.4	14.9	15.9	11.53
Average speed (not including stops)	14.4	14.0	14.5	14.7	15.1	15.3	16.8	12.2
Average current (including stops)	138.3	142.6	138.6	130.2	129.5	90.1	106.6	101.1
Average current (not including stops)	148.7	153.2	151.8	137.4	135.6	92.5	112.4	106.4
Average volts (at the train)	504	498	503	512	516	521	529	509
Efficiency from generators to car axles	51	50.5	52	50	51	51.5	50	47.5
Kilowatt hours per car mile (at the train)	1.32	1.36	1.32	1.69	1.62	1.58	1.76	2.11
Kilowatt hours per car mile (at the station)	1.44	1.52	1.44	1.81	1.68	1.67	1.69	2.21

train weight and the vertical distance the train is lifted. The horizontal effort required to take a train up a grade is equal to the product of the train weight by the per cent. of grade.

Train resistance, as used in this paper, includes all retarding forces other than those due to inertia and grades. Formulas for determining this quantity are empirical and are based upon experimental results, where the conditions have varied widely. D. K. Clark, in "Railway Machinery," recommends a formula which, reduced to tons, of 2,000 pounds, becomes $R = 7.1 + \frac{v^2}{192}$. Another formula in use is $R = 4 + \frac{v^2}{200}$, where R = resistance in pounds per ton of train weight, v = speed in miles per hour. These two formulas have been plotted in Fig. 1, and are marked, respectively, A and B. From measurements taken on the Metropolitan Elevated, the curve, C, has been determined and is used in the following discussions:

In Figs. 2 and 3, are shown actual speed curves on a time and a distance base, for a train running between stations,



FIGS. 1, 2 AND 3.

2,500 feet apart. For the purposes of discussion, consider the train weight as 100 tons. The average speed taken from the curves in the cases cited is 16.5 miles per hour, not including stops. Allowing 12 seconds for a stop, it is 15 miles per hour.

The average rate of using energy or the power, allowing time for stops, is as follows:

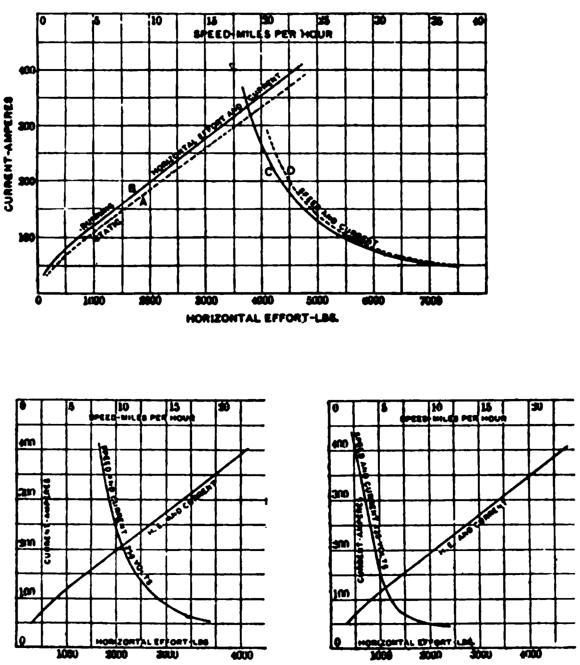
On a 5 per cent. ascending grade ....106.5 h. p.
On a level .... 76.5 h. p.
On a 5 per cent. descending grade .... 46.5 h. p.

The power may also be divided as follows:

For accelerating the train .... 60 h. p.
For ascending grade .... 30 h. p.
For train resistance .... 16.5 h. p.

These figures do not, of course, include losses in applying the power, and only represent the energy which must be applied at the rails to produce the results in the special cases named above. The conditions vary widely at times on the same road, but the above examples may serve to show how great is the percentage of power required to accelerate the trains when the stops are frequent. Motors efficient at high speed are sometimes wasteful of energy because of insufficient torque, at starting and at low speeds, to produce a good form of acceleration curve.

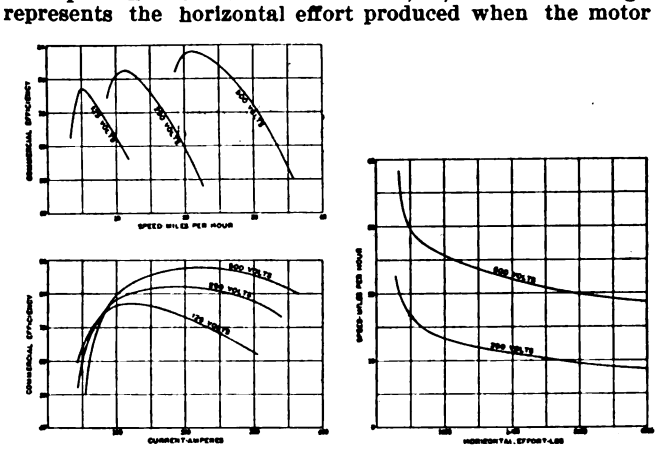
The train weight may be considered as made up of two parts, the live, or paying load, and the dead load, which includes the weight of rolling stock, motors, etc. As the amount of power required by the train varies almost directly as the weight, it is desirable to have the non-paying or dead load as small as possible. Thus, for a service combining high speed and many stops, there are advantages in a form of motor which may be so placed as to utilize a part of the car weight and live load, for purposes of traction. The cars should weigh as little as possible so as to reduce the total dead weight of the train, for it is well known that the ton-miles of paying



FIGS. 4, 5 AND 6.

load form only a small percentage of the total ton-miles moved. On elevated roads it is probably below 6 per cent. on the average and on some roads, below 1 per cent.

The Motors and Controlling Apparatus.—At A, in Fig. 4, the relation between current flowing and the static horizontal effort produced, is shown for the standard motors in use on Metropolitan Elevated Road. Curve, B, in the same figure, represents the horizontal effort produced when the motor is



FIGS. 7, 8 AND 9.

running with 500 volts at the terminals and at the speeds shown by C. The horizontal distance between A and B, represents the loss in horizontal effort due to friction and core losses. Curve, D, in the same figure, gives the speeds which the motor would attain under the conditions named if there

were no internal resistance, and the horizontal distance between the latter curve and C, represents the loss in speed due to such resistance. Thus, the losses in a series motor may be divided into two classes, those that lessen the torque and those that reduce the speed. In Figs. 5 and 6, the relations between current, speed and horizontal effort are plotted for the same motor at 250 and 125 volts.

Curves of efficiency, in relation to the current, are plotted in Fig. 7, for the same voltages. In Fig. 8, the efficiency is plotted to the speed, and it will be seen that the curves fall off rapidly above or below a certain narrow range of speed over which the efficiency is high, at any one voltage.

The relations of speed to horizontal effort are given in Fig. 9. The maximum working range of the motor is from 350 to 4,000 pounds horizontal effort, and the total speed variation on this range at 500 volts will be about 14 miles, and at 250 volts, about 10 miles. With the air at 60 degs. F., and under average working conditions, a Metropolitan motor will radiate heat at the rate of about 650 British heat units per minute. This is equal to 15 horse-power, corresponding about to 60 horse-power of loading. But these motors will readily withstand for a considerable period of time a loading of three times this amount.

The controllers in use on the Metropolitan are two combination series-parallel and have three steps on the rheostat for each voltage. The losses in this apparatus vary from 10 to 20 per cent., depending upon the skill with which it is handled. With care this can be kept down to 10 per cent., making no allowance for the reduced efficiency of the motors at the lower voltages.

The selection of the proper motors and controlling apparatus for a given service deserves more attention than it has generally received. The horse-power and maximum speed have too often been the determining quantities. A rating based on horse-power is now understood to be of little value, and the maximum speed of which a motor is capable may be of still less account as representing its performance with a train. Quite generally, motors have been speeded too high, the result being insufficient starting torque, a poor commercial efficiency and less average speed than a better selected motor would have developed.

The commercial efficiency of railway generators varies from 90 to 95 per cent. Under favorable conditions, the average or "all day" loss for large direct connected machinery (units of over 600 k. w.) is about 7 per cent. Direct connected alternating current generators give about the same efficiency as direct current generators. Commercially, the best results are obtained with a few units of large size. It is unnecessary and poor practice to install many small units for railway work.

A railway load line differs from that of a lighting station in having two nearly equal "peaks," or points of maxima, one in the morning and one in the evening. These variations are best taken care of by cutting in and out units, while the momentary changes can usually be cared for by a slight overloading of the machinery. Engines and generators for railway purposes have a good efficiency over quite a wide range and generally stand overloads very well.

The load curves of the Metropolitan have proven to be a very sensitive index of the traffic. A delay on the competing cable lines or increase of travel from any cause is at once noticeable in the power house. The greater station loading is due not so much to the increased weight in passengers carried, as to the longer stops necessary to discharge and to take on passengers; thus requiring a higher speed to keep the trains on time.

The Efficiency of Transmission.—The energy dissipated between the engine and the car axles may be divided into three parts, that lost in the electrical generators, the losses in the transmission lines (including transformers, rotaries, etc.) and the losses in the car-controlling apparatus and motors.

With machines of 600 to 800-k. w. capacity, the all day efficiency ought to be about 92 per cent. A sub-station provided with rotaries and static transformers working under a good average loading, should have an efficiency of about 89 per cent.; a loss of 8 per cent. in the rotaries and 3 per cent. in the transformers. The sub-station apparatus is at its highest efficiency at the time of greatest loading, when the feeder lines are at the lowest efficiency and thus have a favorable effect on the load line.

The losses on railway feeders vary from 10 to 25 per cent. Often there is sufficient copper if rightly distributed and tied together to reduce this at least one-half. Such a change would also improve the load factor and increase the efficiency of the station.

From a large number of tests made on the trains of the Metropolitan Elevated Road, the following have been selected as illustrating this part of the subject:

Trip No. 1 was made from Franklin street over the Logan Square line with a four-car train, heavily loaded, making an average running time of 13.27 miles per hour. The maximum grade on this line, going west, is 0.75 per cent. ascending for about 2,350 feet, and descending for about 1,950 feet. Other grades do not exceed 0.03 per cent. and only extend short distances.

Trip No. 2 was made with a four-car train, under similar conditions to trip No. 1. In all of the current curves, it is easy to distinguish by inspection when the motors are in series and when in multiple. The stops on the controller are also distinguishable by the greater peaks on the curves.

Trip No. 3 was made under similar conditions to trips 1 and 2, and the data and results are given in the table. Trips Nos. 4 and 5 were made with heavily loaded three-car trains and the results are set forth in the table. Both the speed and commercial efficiency of apparatus are higher than in the case of the four-car trains. Trips Nos. 6 and 7 are with two-car trains and show a higher speed than attained in the case of the three and four-car trains. The greater amount of power consumed in trip 7 is due, mainly, to the increased speed over trip 6.

Trip No. 8 was made with four loaded cars and the motors operating only in series. Both the speed and current are less than for similar trips with the motors operating in series and multiple. The percentage of power saved is greater than that of the reduction in speed, but this is due, not to a better efficiency of the apparatus at lower speeds, but to the fact that the amount of power required to propel a train making many stops, decreases more rapidly than the average speed.

The amount of power lost in the machinery and line, as indicated by the commercial efficiency of the apparatus given in the table, might seem at first thought to be large, but considering the transformation and the distance of transmission, it is certainly not excessive.

Electrical energy can be produced in the vicinity of Chicago, with cheap coal, under the conditions of a railroad load, at less than ½ cent per k. w. hour, and in the form of mechanical energy at the car axles, costing about 1 cent per k. w. hour, it is several per cent. cheaper than it can be generated by steam locomotives. Add to this the actual saving in energy from a more rapid acceleration and from reduced train weight and the total direct advantage for the electrical system is obtained as far as economy in power is concerned.

While any reduction in the cost of power (not only for fuel, but repairs, labor, water, oil and waste, etc.) is of great importance to railroads, the many other advantages of electricity, representing betterments of the service and greater earning capacity are the chief qualities which will determine its adoption in any case in place of steam locomotives. As a motive power electricity is simple, efficient and wonderfully flexible, and it is hardly wise to predict its limitations.

TROLLEY MAIL SERVICE IN MAINE.

The Rockland, Thomaston and Camden Street Railway is the first in Maine to have the United States Railway Mail Service adopted on its road. A separate apartment has been fitted up in a car expressly for the mail service; mails are collected and distributed along the line of the road. The car is 28 feet long over all and is equipped with a Taylor single truck, which has a 6-foot 6-inch wheel base, 33-inch wheels and two G. E. 1,000 motors. The truck is one of the finest riding trucks in the State. The car is capable of running at a very high rate of speed.

The Rockland, Thomaston and Camden Street Railway has just completed a three-quarter mile extension on the Highlands branch. This line runs to the corner of Lime Rock street on the old county road as far as the lime rock quarries. This extension is thoroughly ballasted throughout with lime rock chips and gravel. Mr. T. Hawken is superintendent.

A PULPIT PHRARISEE.

An Indianapolis clergyman made a bitter attack in a so-called sermon a few Sundays ago on ex-President Harrison for appearing as counsel for a street railway corporation in its legal fight against a reduction of fares. "Can any one imagine," asked the reverend gentleman, "the president of a street railroad whose actual value is $2,000,000, but whose watered stock and bonds have a value of $9,000,000, approaching George Washington and offering him $20,000 to justify the greed of the corporation and defend its iniquitous actions from the common people?" And this demagogical gush was applauded.

BROOKLYN HEIGHTS RAILROAD COMPANY has bought sixty new closed cars, twenty each from the St. Louis Car Company, the Laclede Company and the Brill Company.

MISCELLANEOUS

THE EFFECT OF HEAT ON INSULATING MATERIALS.[1]

BY PUTNAM A. BATES and WALTER C. BARNES.

A paper on this subject was presented before the American Institute of Electrical Engineers on May 20, 1896, by Messrs. Sever, Monell and Perry. In the discussion which followed, the results were questioned by several members, and Mr. C. F. Scott cited some investigations of Mr. Skinner, who obtained curves which differed very considerably from those shown in the paper. This left the subject in such an unsatisfactory condition that it was decided to make further tests with the object of reconciling the differences or determining what the real facts are.

In our investigations, more attention has been paid to the actions which take place when one kind of material is subjected to tests while the conditions are varied, rather than a great number of tests on different materials, under the same conditions.

All the tests were conducted on one kind of material, it being safe to conclude from results previously obtained, that the action on it would be quite similar to that produced on other samples. Therefore, the ordinary "red fiber" insulating material having the general appearance of thick red paper has been selected. Its thickness is about .009 inch. The potential used was 500 volts.

The questions that we have attempted to answer by this investigation are four in number, viz.:

1. Does the presence of brass or other metals from which zinc may become volatilized, in the apparatus in which the test is conducted, affect the insulating material or its behavior?

2. Why should one experimenter obtain an insulation resistance curve for fiber, whose minimum point is at about the same temperature as the maximum point of an insulation curve obtained from similar material by another experimenter?

3. What effect on fiber insulating material is produced when it is subjected to conditions similar to those likely to occur in dynamo-electric machinery?

4. What is the action, or actions, that take place when fiber insulating material is repeatedly heated from 20 degs. C. to 200 degs. C.?

Question No. 1 has been approached in the following manner: The resistance of the insulating material at the temperature of the air, or 20 degs. C., being determined, the temperature is gradually raised until 200 degs. is reached, when the test is discontinued. The time taken for this rise was exactly 2½ hours. Resistance measurements were made at frequent intervals, and from these a curve was plotted. The area of insulation tested being 5.5 square inches thickness equals .0095 inch. The position and shape of the curve agrees very closely with the results obtained by Messrs. Monell and Perry, who in their experiment used a brass cylinder, but a confirmatory test with a brass cylinder was also made in our apparatus.

In taking up question No. 2, it is intended to prove, by comparative tests, that the position of the maxima and minima points of the resistance curves, depend upon the opportunity of escape given to the moisture originally contained in the specimen.

It is clear from these two experiments that the position of the curve may be shifted at pleasure by simply varying the opportunity for the escape of the moisture originally contained in the insulating material.

Question No. 3. A new specimen of plain red fiber .009 inch thick was wound with four layers of No. 26 B. & S. bare copper wire, the area covered being 4 square inches, and then subjected to the variations in temperature and exposure to moisture which are most likely to take place in dynamo electric machinery.

Examination of the curves obtained shows that the specimen after exposure to moisture returns to its original condition.

The following conclusions are arrived at by the authors:

(a) The presence of brass in the apparatus does not affect the shape and position of the curve.

(b) The difference in the curves depends solely upon the amount of moisture contained in the material and its opportunity of escape.

(c) Every time the specimen cools the resistance increases to a value much above any resistance that it possessed before, provided it is kept from absorbing moisture.

It is impossible to determine the limit of this action with the present apparatus. But all the curves clearly show this stepping-up effect, which is practically the same as the well known result obtained by baking insulating materials.

[1] Read before the Amer. Inst. Elec. Engrs. Abstract.

TELEPHONY AND TELEGRAPHY

THE ADER CABLE RECORDER.

At the meeting of the Paris Académie des Sciences, last month, M. Ader, of telephone fame, described a new form of submarine telegraph instrument of exceeding beauty, and destined maybe to prove of great practical use. The Ader recorder consists simply of a very fine wire (0.02 mm. in diameter) stretched between the poles of a powerful permanent magnet, in an exceedingly narrow air space. When currents are sent through the stretched wire it tends to move forward or backward in the magnetic field, and these oscillations are recorded in the following manner: The light of a lamp is directed, through a hole in one of the pole-pieces, upon the wire, the size of which is here enhanced by a small cylinder of pith; on the far side of the oscillating wire there is a narrow slit, across which a strip of gelatino bromide of silver paper runs, and on which the movements of the wire are consequently permanently recorded, the paper, after it passes the slit, running straight through a fixing bath. The Adder recorder has been tried on the Brest-St. Pierre cable (2,271 knots), and on the Marseilles-Algiers cables (499 knots). On the Atlantic cable 600 signals per minute were attained as against 400 with the siphon recorder. On the Mediterranean cables signals sent at the rate of 1,600 a minute were easily read.

INDEPENDENT TELEPHONY IN TENNESSEE.

A special dispatch from Knoxville, Tenn., of July 8, says: The Association of Independent Telephone Exchanges of Tennessee was formally organized here to-day. It is intended to include every independent exchange in the State. The organization is the outgrowth of the recent convention of telephone men in Detroit. Its purpose is to fight the Bell system.

THE EFFECT OF SEA WATER ON INDUCTION TELEGRAPHY.

At the last meeting of the Physical Society a mathematical paper was read by Mr. C. S. Whitehead on "The Effect of Sea Water on Induction Telegraphy." If a secondary circuit containing a telephone is rightly placed with respect to the field of a primary circuit traversed by an alternating current, signals may be transmitted over considerable distances. The author investigates the effect of filling the intervening space with sea water; and, generally, the effect of a spherical conducting shell on the induction, at a point in a dielectric, due to an alternating current in a circular circuit, when the axis of the conductor passes through the center of the shell. In the mathematical treatment two cases are considered: 1. To find the normal magnetic induction at any point in the dielectric outside the shell, when a circular circuit carrying an alternating current is placed in the dielectric inside a spherical conducting shell. 2. To find the normal magnetic induction at any point on the remote side of an infinite conducting plate, due to a circular circuit parallel to the plate.

A WESTERN UNION BOY.

The Western Union Telegraph Company's "messenger boy" at Branford, Conn., is Frederick Miller, aged 87, who has a local reputation for his long walks. A message came addressed to a man in North Branford the other day, five miles from the Branford office. Miller started out, and when he got to North Branford he found that the man lived in Northford. On he went, five miles more, found his man, delivered the message and started back, covering a distance of twenty miles.

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SUBMARINE CABLES AND THEIR REPAIR.

THE well known cable steamer "Minia," Captain Trott, belonging to the Anglo-American Telegraph Company, arrived at the port of St. Johns, N. F., on the 12th of June, after accomplishing a very important repair on one of the Western Union Company's cables in over 2,500 fathoms of water in longitude 39 degs. west. She sailed from that port on the night of May 23, so that this marvelous feat, including the voyage to and from the position, was completed in less than three weeks, although the weather during the time was reported by all the incoming steamers to be worse than any known at that season for many years. The "Minia" also on her arrival reported much bad weather—she had only three fairly good working days; but, notwithstanding the difficulties encountered on account of the weather, she was only eleven days from recovering the western end until the repair was completed. It is also said that had it not been for a fault in the insulation near the English shore, which had been reported to have been cut out a short time previous by the steamer "Chiltern," and which vitiated the tests taken on board, the repair would have been completed in three days. In the month of April last Captain Trott was visiting this city, and to a few friends, who were calling on him, he said: "I intend on this job—if I get half a chance—to break all records, and to eclipse anything that has ever been done, or likely to be done for some time to come in deep water cable repairing." We are glad to congratulate him on thus breaking his own record.

While on the question of submarine cables, we are reminded of the fact that within a few years there have been some eight breaks in the newest and most modern type of cables, four of which have been very near the longitude of 40 degs. west. By reference to charts, and also from what little we gather by inquiry about the repairs, we learn that the depth of water is almost uniformly about 2,500 fathoms, and that the nature of the bottom is favorable for the preservation of cables. This being so the question naturally arises, what is the cause of so many disasters to the cables, involving as it does such enormous sums of money in the hire of special ships, and in the expenditure of new cable in effecting the repairs? We well remember the failures of two of the largest sized ships in the years 1893-94, involving as it did in both cases another expedition to go out and begin the work de novo in the following years; with the disadvantage of having long lengths of the cables destroyed in the previous years. In the above cases, the hire of ships alone must have been almost a fabulous sum, as the time amounted to nearly six months in each case. The amount of cable used on such repairs usually exceeds eighty miles and often more than 100. Calculating cable at $1,100 per mile and ships at $1,400 per day, our readers may form some estimate of what it costs to keep telegraph submarine ocean cables in working order, to saying nothing about their renewal.

We would be glad if the veteran cable repairer, to whom we have referred above, Captain Trott, of whom it has been said "that he knows the bottom of the Atlantic as a cabman knows the streets of a city" would give us some information on the cause of such destruction to cable property. It would be of incalculable benefit to those who invest their money in such enterprises.

COLLEGES IN POVERTY.

IT is said that if Governor Hastings, of Pennsylvania, had not signed the bill appropriating $150,000 for the support of Lehigh University the institution would have had to close its doors, owing to the failure of the Lehigh Valley Railroad to pay dividends on the stock left as an endowment by Asa Packer. The news of financial distress has been received with surprise and pain, as it was supposed that Lehigh was rich and strong, both in present funds and in its prospective receipt of other endowment. But it is now understood that the income of last year was chiefly derived from tuition fees, although it was the design of the founder that the excellent special training at Lehigh should be free of charge. Last year 415 students were in attendance. Outside the gifts at the foundation, to build the university, Mr. Packer left $1,500,000 for endowment and $500,000 for a library, little dreaming that a time could come when the profitable Lehigh Valley road would fail to yield a handsome return.

The money available for technical education is still so small, one dislikes greatly to see it reduced or in peril in this manner; but, falling back on the State does not commend itself to our judgment, nor is the incident unique. We wish it was. The wonder is that with 400 colleges in this country granting degrees and diplomas, the number of those that come to grief is not larger. Perhaps if we had 100 colleges, things might be better, but even the seats of learning of the best type or largest resources totter now and then. The parlous condition of Johns Hopkins is familiar history, and everybody knows that Palo Alto escaped great disaster by the skin of its teeth. Nor are evil days limited to modern institutions, for Oxford and Cambridge have both been affected seriously by the decline in the value of English farm lands. Nor is the phenomenon one that is new. The University of Geneva was once so hard up that it was in danger of closing its doors, and the Company of Pastors offered their own salaries to find bread for the professors. At the beginning of the sixteenth century, the University of Paris was in deep decay, forty of its colleges were empty of students, and many of the buildings were overgrown

with verdure. But to-day both are strong and prosperous. Perhaps it is as impossible to secure a university against the downs of fortune, in perpetuity, as any other institution, for stocks, bonds, lands, city estates and all other forms of earning funds, are liable to vicissitude; but there are certainly remedies for the state in which many of our American colleges find themselves, and one of these would be that favorite modern process of consolidation.

A PIOUS PILGRIMAGE.

WE give a report of the meeting this week of the American Institute of Electrical Engineers at Greenacre-on-the-Piscataqua, Me., held at that spot in order to assist in celebrating the jubilee of the operation by Prof. Moses G. Farmer, of an electric passenger road at Dover, N. H., near by, the work in electricity of that brilliant but diffident and reserved inventor, dating from that period. It was hardly expected that in a remote corner of Maine a national society could get many of the members together, but the attendance was good and representative and some excellent work was done. Not the least of many pleasing recollections of the week will be the charming hospitality of Miss Sarah J. Farmer and her associates in the Greenacre Conference; while it may be hoped that a permanent record will be found in a memorial to Prof. Farmer himself and the publication of some of the valuable data now lying lost in his 15,000 pages of experimental records, preserved at his quiet Greenacre home.

THE NEW TARIFF.

THE new tariff schedule, which went into effect last week, will, in general, affect the electrical industries very little, such increases in the rates as have taken place being upon products of minor import. The notable exception to this, however, is the duty on arc light carbons, which has been increased from 20 per cent. ad valorem to 90 cents per 100, or $9 per 1,000. This increase is one of the largest, if not the largest. on the entire list, representing a duty of anywhere from 50 to 150 per cent., depending on the size of carbon. It is more than probable that this high rate will effectually shut out carbons of foreign make for the present. Yet there are some who believe that, in spite of its increased cost, the quality of the imported article will make its use desirable in enclosed arc lamps, for instance. American carbon manufacturers now have a great opportunity of showing what they can produce, and we hope that they may succeed in their attempts to furnish a carbon equally as good as, or better than, the imported.

PROF. ELIHU THOMSON AND X-RAYS.

ONE of the most noteworthy signs of the day is the manner in which the daily press takes up the new things in science and invention and makes the knowledge of them common property. Very often this is done in a sensational way, but, even when at its worst, the mere fact that crime is not the only side of life to think about is impressed in this not altogether useless way upon a public that would hardly otherwise know anything at all of intellectual and industrial advance. There are some journals that treat these subjects in a dignified yet helpful and interesting style, and chief among them is certainly the New York "Sun." It is for this reason that we may be the more free to correct statements made by it which, if made by some of its inestimable contemporaries, would be passed by with silent contempt. Thus, an article in the "Sun" for Sunday, July 18, on the danger of the X-rays may be mentioned as one of those in which the writer, though probably good in purpose, falls lamentably short of the "Sun's" average high standard of accuracy. Reference in it is made to the work of various men, and that of one of them, Prof. Elihu Thomson, is, to say the least, ludicrously misrepresented. It will be remembered that Prof. Thomson recorded in the electrical papers the results of an experiment made deliberately with his little finger to determine certain facts as to X-ray inquiry for himself. The "Sun" article says that he did this in ignorance and "acknowledged his error in a lecture" and exhibited his finger "as proof that he had been wrong." It is a hard fate to martyrize even a little finger in the cause of science, and then to have it thus paraded as having been done in the cause of ignorance. Prof. Thomson's purpose was obviously to show that the X-rays were to blame for the trouble, but, at the same time, he wished to allay apprehension of injury when proper conditions were observed, realizing that the beneficent use of the rays in surgery might be hindered if people should acquire an exaggerated notion of the risk of injury. When Prof. Thomson gave his valuable data, there were all kinds of theories in the air, as to electro-static effects, thermal effects, ozonic effects, etc., and his experiments went to show, and it would seem, resulted in proving that the burns were due to the rays themselves. And yet the "Sun" man goes out of his way to talk of Prof. Thomson's "errors" and avowal of ignorance. As we recorded the original tests, we object very decidedly to this gross perversion of fact and history, which might well make Prof. Thomson glad that he risked only a little finger.

THE TROLLEY DECISIONS.

THE decision of the U. S. Circuit Court of Appeals, reversing the order of Judge Coxe, who granted a preliminary injunction against the Hoosick Railway Company, will come as a surprise, albeit a by no means disagreeable one, to all interested in electric railway work. For the time being it leaves the use of the trolley free in the judicial district covered by the Second Circuit. In one sense it is a heavy blow to the validity of the Van Depoele trolley patent, as foreshadowing to some extent, at least, the final opinion of the court. But, on the other hand, it must not be forgotten that the case was not before the Appellate Court on final hearing, the question being simply whether Judge Coxe was justified in granting the injunction. It will be recalled that in the U. S. Circuit Court of Appeals for the Sixth Circuit, where the same question was at issue, the court below was sustained in its decision granting an injunction against alleged infringers. Considering the fact that two Appellate Courts have taken opposite views on the same question, there is probably little doubt that the U. S. Supreme Court will be asked to take up the case for adjudication. Another point to be considered is the fact that of the sixteen claims of the trolley patent, but five were involved in the Hoosick case. There are other claims which the owners of the patent claim to be of importance and which have only recently been passed upon.

These additional claims were involved in a suit brought against the Detroit Citizens' Street Railway Company in the Circuit Court of the United States, Eastern District of Michigan. In that case an order for a preliminary injunction was granted July 15, the defendants being enjoined from infringing the second and fourth claims, as well as those specified in the Hoosick case. The bill of complaint in the Hoosick case, we understand, has been amended and the courts of the New York Circuit will be asked to consider these additional claims with the others, when the case comes up for final hearing. The decision just rendered, of course, in no way affects the Van Depoele patent on the under-running suspended switch for trolley circuits, and the General Electric Company will probably take some comfort in the fact that on July 15 the Detroit Citizens' Street Railway Company was also enjoined from using the suspended switch on its system. So far as the trolley itself is concerned, honors appear to be about even, and it will probably be several years before a final decision in the matter can be reached.

THROUGH an error of the engraver the designation "Hours" was omitted for the abscissa line of the engraving, Fig. 1, page 75 of this issue. Likewise in Fig. 2, on the same page, the ordinates represent "Watts per Candle" and the abscissæ "Hours."

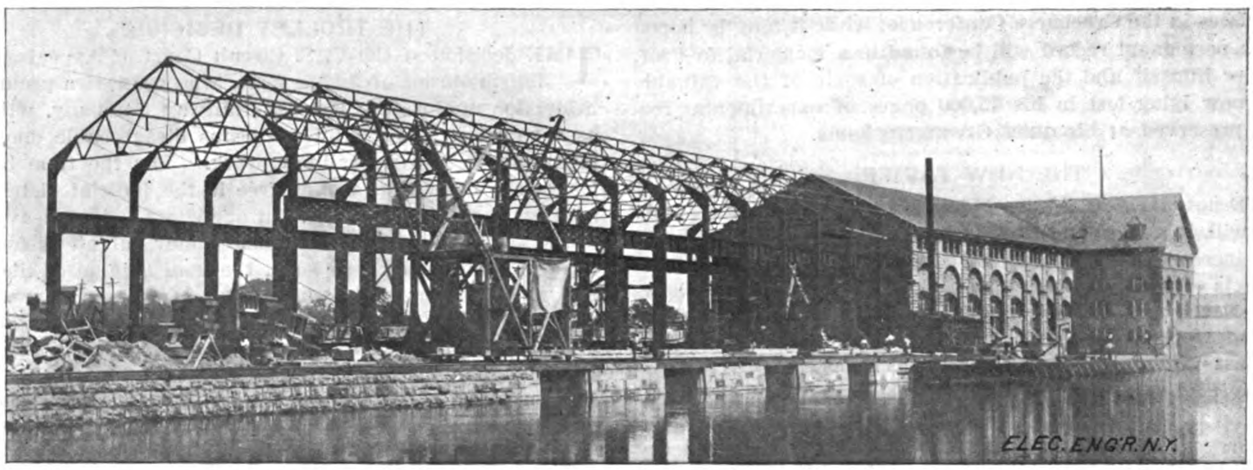
NIAGARA POWER HOUSE EXTENSION.

By ORRIN E. DUNLAP.

THE steel frame of the extension of the Niagara Falls Power Company's power house has been erected, and Contractors R. D. Young & Co. are erecting the masonry. The original section of this great power station is 140 feet long, and the extension is 286 feet, making a total length of 426 feet. This total length will afford room for ten 5,000 horse-power generators of the same style as those in use at present, and five of the seven additional generators have been ordered of the Westinghouse Electric and Manufacturing Company. The additional turbines have also been contracted for, and will be made by the I. P. Morris Company, of Philadelphia.

In the extension the same pleasing style of architecture will be adhered to as that which is so pronounced and beautiful in the first section of the building. E. D. Smith & Co., the firm having the contract for the extension of the wheel pit, have finished the excavation necessary under their contract, and the work of bricking up the lower portion to a height of about 30 feet is about to commence. This brick wall will be about 30 inches thick and about 1,500,000 brick will be used in building it.

Resident Engineer Brackenridge, of Cataract Construction Co., is hurrying the work with all possible speed. Mr. Brackenridge's experience on the original section of the work has proved very valuable during the work of extension, and has been a material factor in the progress made. When completed the imposing nature of the power house will be greatly increased, as is evident from the illustration presented herewith.



THE NIAGARA POWER HOUSE EXTENSION.

THE ALTERNATING CURRENT INDUCTION MOTOR.[1]—I.

BY CHARLES PROTEUS STEINMETZ.

POLYPHASE INDUCTION MOTOR.

Load Curves.—In its general behavior the alternating current induction motor is analogous to the continuous current shunt motor. Like the shunt motor it operates at approximately constant magnetic density. It will run at fairly constant speed, slowing down gradually with increasing load. The main difference, however, is that in the induction motor the current is not passed into the armature by a system of brushes, as in the continuous current motor, but induced in the armature by the alternating field, and in consequence thereof, the primary circuit of the induction motor fulfills the double function of an exciting circuit corresponding to the field circuit of the continuous current shunt motor, and an inducing circuit producing the current in the armature by electromagnetic induction.

The secondary or armature of the motor consists of two or more circuits displaced in phase from each other so as to offer a closed secondary to the primary circuits, irrespective of the relative motion. The primary consists of one or several circuits.

The characteristics of the transformer are independent of the ratio of transformation, other things being equal. That is, doubling the number of turns for instance, and at the same time reducing their cross-section to one-half, leaves the efficiency, regulation, etc., of the transformer unchanged. In the same way in the induction motor it is unessential what the ratio of primary and secondary is, or, in other words, the secondary circuit can be wound for any suitable number of turns, provided the same total copper cross-section is used. In consequence thereof the seconodary circuit is mostly wound with one or two bars per slot, to get maximum amount of copper; that is, minimum resistance of secondary.

In the following under secondary current, e. m. f. impedance, etc., shall always be understood their values reduced to the primary, or corresponding to a ratio of turns 1 to 1, although in practice a ratio 1 to 1 will hardly ever be used, as not fulfilling the condition of uniform magnetic reluctance desirable in the starting of the induction motor.

Let in the polyphase induction motor,

$Y_0 = g + jb$ = primary admittance, or admittance of the primary circuit at open secondary circuit.

$Z_0 = r_0 - jx_0$ = primary impedance.

$Z_1 = r_1 - jx_1$ = secondary impedance induced to the primary by the ratio of turns.[2]

All these quantities refer to one primary circuit and one corresponding secondary circuit.

The "efficiency" or "power efficiency" is the ratio of the true mechanical output of the motor to the output which it would give at the same power input if there were no internal losses in the motor. The "apparent efficiency" or "apparent power efficiency" is the ratio of the mechanical output of the motor to the output which it would give at the same volt-ampere input if there were neither internal losses nor phase displacement in the motor.

The "torque efficiency" is the ratio of the torque of the motor to the torque which it would give at the same power input if there were no internal losses in the motor.

The "apparent torque efficiency" is the ratio of the torque of the motor to the torque which it would give at the same volt-ampere input if there were neither internal losses nor phase displacement in the motor.

From the quantities: Primary aumittance, primary impedance and secondary impedance, the induction motor can be calculated.

As instance, in Figs. 1 and 2 are calculated the load and speed curves of a 60-cycle three-phase eight-polar motor, 110 volts impressed, of the constants: $Y_0 = .045 + .384\,j$; $Z_0 = .045 - .124\,j$; $Z_1 = .041 - .124\,j$ per circuit in delta connection. 510 watts are allowed as friction at synchronism.

The output and torque are three times the values derived directly from calculation since the motor contains three cir-

[1]Read before the Amer. Inst. Elec. Engrs. Abstract.

[2]The self inductive reactance refers to that flux which surrounds one of the electric circuits only without being interlinked with the other circuits.

cuits, an.. the current shown in the diagrams is the current per line, or $\sqrt{3} \times$ the current derived from calculation.

In Fig. 1 are shown in drawn lines the speed, efficiency and current input ot the motor with the h. p. output as abscissæ, in dotted lines the apparent efficiency, and in dash dotted lines the power factor.

In Fig. 2 are shown with the speed or the slips in per cent. of synchronism as abscissæ, the torque as ordinates for the three-phase armature resistances: $r_1 = .041$, or short-circuited armature; $r_1 = .38$; $r_1 = .76$. This motor is the I-8-30-900-110, Form A, of General Electric Company's make, and the results of test of this motor are marked in Figs. 1 and 2 by crosses,

which may be called the characteristic constant of the motor.

The power factor of primary admittance $\beta = \frac{g}{y}$.

The power factor of impedance $\gamma = \frac{r}{z}$.

In the above equations, y equals the absolute admittance; z equals the absolute impedance, and g equals the conductance.

The characteristic constant of the induction motor $\vartheta = 2\,yz$ is the ratio of exciting current to short-circuited current.

The characteristic constant is also approximately the ratio

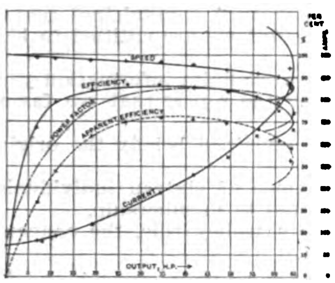


Fig. 1.
I-8-30-900-110, Form "A." 60 Cycles, 8 Poles, 110 Volts. Three Phase. Curves calculated with: $Y = .065 + .304j$; $Z_0 = .048 - .124j$; $Z_1 = .041 - .124j$. Friction: 800 Watts at Synchronism. Observed by Test: ×.

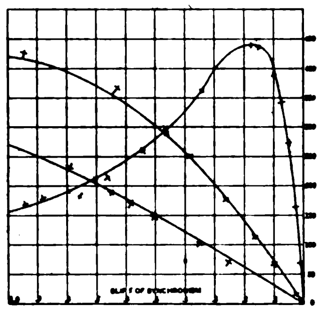


Fig. 2.
"I-8-30-900-110, Form "A." 60 Cycles, 8 Poles, 110 Volts. Three Phase. Curves calculated with: $Y = .065 + .304j$; $Z_0 = .048 - .124j$; $Z_1 = .041 - .124j$. Friction: 810 Watts at Synchronism. Observed by Test: ×.

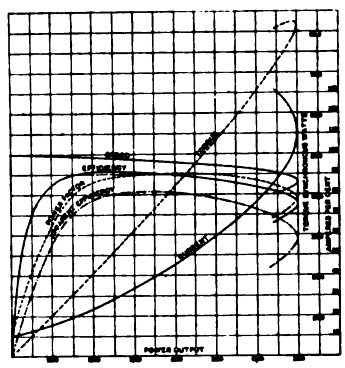


Fig. 3.—Induction Motor. Load Curves. $Z = .1 - .3j$. $Y = .01 + .1j$.

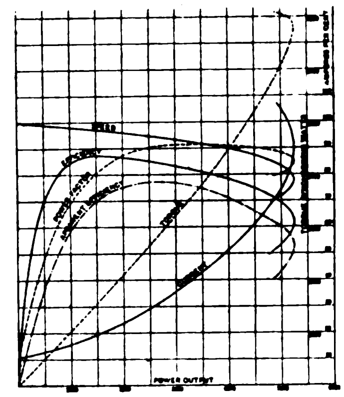


Fig. 4.—Induction Motor. Load Curves. $Z = .2 - .3j$. $Y = .01 + .1j$

FIGS. 1, 2, 3 AND 4.

showing the exceedingly close agreement between the calculated values and the results of test.

Equations show that in an induction motor, the efficiency, power factor, apparent efficiency, torque efficiency, apparent torque efficiency at a given slip or speed, and thus starting torque per volt-ampere or watt input are independent of the impressed e. m. f. The current and counter e. m. f.'s are proportional to the impressed e. m. f.'s.

The torque, power and volt-amperes are proportional to the square of the impressed e. m. f. This obviously applies only as long as the iron is below saturation, which, however, is always the case.

Rating the induction motor at a given percentage, say, ⅔ of maximum output or of maximum torque, the characteristic features of the motor are seen to be entirely independent of

of total self-inductance to mutual inductance of the motor circuits.

To exhibit the effect of the variation of constants on the behavior of the induction motor, a number of characteristic motors have been calculated and the load curves of some of them are shown in Figs. 3 to 7, while an abstract of their constants is given in the accompanying table.

No. 1, with load curves shown in Fig. 3, refers to the best motor which can be built at frequencies of 40 to 60 cycles. As seen, the efficiency rises very rapidly at light loads, reaches a maximum of 91 per cent., and then slowly drops to 88 per cent. at full load. The power factor rises somewhat slower, but is already 74 per cent. at quarter load. The apparent efficiency is very high also, above 80 per cent., and rises at light loads quite rapidly. The exciting current is very small.

CONSTANTS OF INDUCTION MOTORS.

$E_0 = 110.$

(The motors marked by × are typical motors.)

No of motor.	No. of diagram.	$Y = g + jb$	$Z = r - jx$	$\vartheta = 2yz = y(z_0 + z_1)$	$\beta = \frac{g}{y}$	$\gamma = \frac{r}{z} = \frac{r_0 + r_1}{z_0 + z_1}$	T_m = max. torque, synchr. kilowatt.	P_r = rated output, kw. at ⅔ T_m.	P_m = max. output, in per cent. of P_r.	s = slip, at P_r	Exciting current, per cent. of current at P_r	Power Factor at full load.	Power Factor at ½ load.	Power Factor at ¼ load.	Efficiency at full load.	Efficiency at ½ load.	Efficiency at ¼ load	Apparent efficiency at full load.	Apparent efficiency at ½ load.	Apparent efficiency at ¼ load.
		.005 + .05j	.1 − .3j	3.18	10.0	31.6	9.00	5.65	1.38	6.3	3.7	96.6	95	91	85	93	93.5	82.2	88	85
		.01 + .1j	.05 − .3j	6.12	10.0	16.4	8.90	5.75	1.42	3.2	16.7	88.7	88.7	77.8	92.4	93.5	90.8	82	83.1	70.5
×1	3	.01 + .1j	.1 − .3j	6.35	10.0	31.6	8.35	5.15	1.38	6.3	17.4	89	88.5	74	86.5	91.2	88.2	77.4	81	65
×2	4	.01 + .1j	.2 − .3j	7.28	10.0	55.4	7.10	4.20	1.25	11	19.5	91	88.4	71	76	86.5	85	69.2	76	60
		.01 + .1j	.4 − .3j	10.04	10.0	80.0	5.30	2.90	1.12	6 18	25.0	93	88	57	66	85	90	61	70	51
		.02 + .2j	.1 − .3j	12.70	10.0	31.6	7.90	4.95	1.25	6.3	33	88	74	55	84	87	80	70	64.5	44
		.02 + .2j	.2 − .3j	14.22	10.0	55.4	6.80	4.00	1.26	11	36	85	72	50.5	75.5	80.6	74	64.2	58.2	37.5
×4	6	.04 + .4j	.05 − .3j	24.44	10.0	16.4	7.90	5.10	1.42	3.2	51.4	60.4	55	37	86.4	88	72.5	60.5	45.5	27
×5	7	.02 + .4j	.1 − .3j	25.35	5.0	31.6	7.60	4.75	1.25	6.3	52	71	64	36	88	82.3	75	56.2	44.5	28
		.04 + .4j	.1 − .3j	25.40	10.0	31.6	7.30	4.55	1.65	6.3	53.5	71	54	36	79.7	79	69	56	42.5	25
×8	5	.04 + .4j	.3 − .3j	34.20	10.0	70.7	5.50	3.10	1.12	16.5	62.5	75	56	37	60.6	61.3	47	43.3	32.5	17
		Single	phase	Motors:																
1_1		.08 + .3j	.1 − .3j .033 − .1j	12.72	10	31.6	9.9	6.4	1.48	2.8	36	88	73	52.5	84.5	85	78	70	61.5	40.5
2_1		.08 + .3j	.2 − .3j .067 − .1j	14.88	10	55.4	7.5	4.8	1.36	4.3	44.3	85	67.5	47	74.5	78	60	58	53	28.5
4_1		.12 + 1.2j	.05 − .3j .0167 − .1j	48.88	10	16.4	8.8	5.8	1.48	1 9	73	52	36	24.5	76	69	58	69.5	24.5	13
5_1		.08 + 1.2j	1 − .3j .033 − .1j	50.7	5	31.6	7.75	5.0	1.41	3.4	78	53.5	35	24	69.5	62.5	47.5	37	22	11
8_1		.12 + 1.2j	.3 − .3j .1 − .1j	68.4	10	70.7	4.3	2.67	1.33	6.8	92	60.5	46.7	33.5	40	26.6	17	24.3	12.5	6.8

the impressed e. m. f. and merely dependent upon the admittance and the impedances.

A change of one of the impedances has comparatively little effect on the motor characteristic, provided that the other impedance is changed so that the total impedance remains the same.

Thus the induction motor is characterized by three constants only: The product of admittance and impedance $\vartheta = 2\,yz$,

The drop of speed, 6 per cent., at full load, could be made less by lessening the armature resistance. In very large motors as close a speed regulation as 1 to 1½ per cent. has been reached. Thus this motor is equally as satisfactory at light loads as at heavy loads.

No. 2 in Fig. 4 shows the typical high resistance motor. It is characterized by poor speed regulation, a drop of 11 per cent. at full load, an efficiency curve reaching very high values

at light load, but falling off with load, while the power factor rises slowly, but reaches very high values at heavy loads. The apparent efficiency is quite fair and the exciting current the same as in the first motor, thus due to the decreased output of this motor a somewhat higher percentage of full load current, when rating the motor at ⅜ maximum torque.

SOCIETY & CLUB NOTES

NORTHWESTERN ELECTRICAL ASSOCIATION.—FIFTH SEMI-ANNUAL CONVENTION, LA CROSSE, WIS., JULY 21-22 1897.

THE fifth semi-annual convention of the Northwestern Electrical Association was held at La Crosse, Wis., at the City Hall, July 21 and 22, 1897.

The meeting was called to order by Vice-President G. L. Cole, of Beloit, Wis., in chair, at 10:50 A. M.

The following were in attendance:

E. H. Abadie, St. Louis, Mo.; R. A. Albrecht, La Crosse, Wis.; Herman Andrae, Milwaukee, Wis.; C. W. Bacon, Madison, Wis.; W. Worth Bean, St. Joe, Mich.; G. C. Bell, La Crosse, Wis.; F. N. Boyer, Chicago, Ill.; Loren W. Burch, Madison, Wis.; G. L. Cole, Beloit, Wis.; Columbia Incandescent Lamp Company, St. Louis, Mo.; F. A. Copeland, La Crosse, Wis.; A. A. Cross, West Superior, Wis.; George Cutter, Chicago, Ill.; E. L. Debell, Sheboygan, Wis.; James R. Dee, Houghton, Mich.; Fred. De Land, Chicago, Ill.; Henry L. Doherty, Madison, Wis.; Casper Faust, Rhinelander, Wis.; T. Ferris, Milwaukee, Wis.; F. H. Ford, Madison, Wis.; G. B. Foster, Chicago, Ill.; A. C. Garrison, Madison, Wis.; H. J. Gille, St. Paul, Minn.; G. H. Greenwood, La Crosse, Wis.; H. C. Hackney, Madison, Wis.; Jos. M. Hill, Chicago, Ill.; L. B. Howorth, Minneapolis, Minn.; I. D. Hurlbut, Prairie du Chien, Wis.; George H. Jones, Fond du Lac, Wis.; C. E. Kammeyer, Chicago; John S. Keller, Prairie du Chien, Wis.; F. Kellogg, Spencer, Ia.; F. J. Killian, La Crosse, Wis.; P. H. Korst, Racine, Wis.; I. B. Kuntesen, La Crosse, Wis.; A. N. Loper, New Haven, Conn.; W. W. Low, Chicago, Ill.; F. P. Luther, Chicago, Ill.; G. G. Luthy, Peoria, Ill.; J. H. McGill, Chicago, Ill.; T. Julian McGill, Chicago, Ill.; J. D. McIntyre, P. S., Syracuse, N. Y.; F. McMaster, Chicago, Ill.; John S. Maurer (Crouse-Tremaine Carbon Company), Fostoria, Ill.; Thomas R. Mercein, Milwaukee, Wis.; C. M. Morgan, Preston, Ill.; George M. Newton, Sparta, Wis.; Pliny Norcross, Janesville, Wis.; C. C. Paige, Oshkosh, Wis.; H. F. Pearce, Negaunee, Mich.; C. H. Pease, Richland Center, Wis.; W. S. Raymond, L. D. Richardson, La Crosse, Wis.; J. H. Schlake, Freeport, Ill.; R. F. Schuchardt, Milwaukee, Wis.; John Schuette, Manitowoc, Wis.; George D. Shepardson, Minneapolis, Minn.; James J. Sheridan, La Crosse, Wis.; W. R. C. Smith, Chicago, Ill.; M. L. Stevenson, Cleveland, O.; George S. Stiles, La Crosse, Wis.; W. P. Sullivan, Chicago, Ill.; R. A. Swain, Chicago, Ill.; G. L. Thayer, Belle Plaine, Ia.; W. H. Upham, Marshfield, Wis.; W. P. Upham, Chicago, Ill.; P. Valier, La Crosse, Wis.; Geo. S. Whyte, Chicago, Ill.; James Wolff, Chicago, Ill.

The vice-president opened the proceedings by a short address, after which the report of the secretary and treasurer was read by Mr. T. R. Mercein, to whom a hearty vote of thanks was accorded.

The Programme Committee then presented its report.

The secretary said that there had been considerable discussion in previous conventions in regard to the action of manufacturing institutions, and read the following letter, under date of June 21, 1897, relative to the proposed municipal plant at Racine, Wis., addressed to the secretary:

"Dear Sir: On my return to-day, find your inquiry of the 14th inst. In connection with this matter, desire to state, we are in no wise interested in Racine, Mr. Roberts or a municipal plant for Racine. We have heretofore sold Mr. J. I. Case considerable apparatus, and it is not likely we would enter the field, establishing an electric plant in opposition to him.

"Some time ago we wrote our representatives regarding municipal ownership, as per the enclosed letter. This, from the fact that some parties connected with the Northwestern Electrical Association stated we were endeavoring to install municipal plants.

"Please understand we feel there is no company in the United States that has lost as much money by municipal ownership as ourselves. We owned two lighting plants at Detroit, when municipal plant was established; one of these plants was thus rendered practically worthless. At Logansport, Ind., we also lost a plant valued at $80,000; this is now closed up with only a watchman in charge.

"Trusting the above explains our position in the matter, we remain, very truly, C. C. KNIGHT,
Vice-President Fort Wayne Electric Corporation."

The letter referred to is a circular letter issued by the Fort Wayne Corporation to its agents and concludes as follows:

"We have always opposed municipal ownership where companies are in existence and never have taken a part in the establishment of municipal plants until the local people are absolutely unable to secure lighting contracts and the city, town or village has advertised for proposals to the end of letting a contract for the establishment of a municipal plant. On receipt of such information we feel we are entitled to bid on said work.

"We would be pleased to have any definite information you may have as to parties circulating the report that we favor municipal ownership."

MR. P. H. KORST, of Racine, explained briefly the origin of the Racine inquiry.

The secretary then read the names of sixteen individuals and corporations who were admitted to membership.

After accepting an invitation to a trolley ride, the convention adjourned till 2 o'clock P. M.

AFTERNOON SESSION.

The association was called to order by the vice-president.

The secretary then presented two applications for membership, which were acted on favorably.

A paper was then read on "Utilization of Exhaust Steam," by Mr. George L. Thayer, of Iowa.

MR. DOHERTY inquired whether Mr. Thayer could give any figures on the installation charge per unit of income, say, $100 of income.

MR. THAYER.—Figuring on the basis of 100 horse-power, it will bring about $2,500 income after you have fully loaded up your mains. Auxiliary apparatus and power house will cost about $5,000. Of course, there comes in the added expense of installing the apparatus in the building, which is about $20 per horse-power. I presume you could turn over your capital about once in three or four years if your conditions are favorable. A heavy condensation loss and main loss might become important factors, however. A 6 or 8-inch main costs pretty near a dollar a foot to lay.

MR. DOHERTY.—I think you would get about the same return as we do on our lighting plant as compared with our installation charge.

MR. THAYER.—It is claimed that under good conditions a plant will last twenty years. There are small underground mains that were installed by the firm for which I worked, that I know are in good condition after fifteen years' use. Pipe laid in tiling would have too much conduction loss. It has been a practice to use nothing except a wooden log or trough, except in New York City, where brick tunnels are employed on account of the heavy service. Two thousand five hundred dollars is the gross income. The profit depends entirely upon how much exhaust steam one has.

MR. DOHERTY.—We have a street railway built at home and I was figuring on storage batteries to carry the peak of the load. Their first cost would be in the neighborhood of one-fifth more than the entire equipment of engines, boilers and dynamos in the plant. Their efficiency would be about 80 per cent. The Chloride Company would not guarantee to maintain them for less than 7 per cent. In connection with the use of exhaust steam I came to the conclusion that in our circumstances we gain more by condensing than by exhaust steam. A great many stations are equipped with high speed engines that are not adapted to run condensing, and the exhaust steam is wasted entirely. But I think a great many of us could make a marked saving by looking up the question of condensation.

MR. THAYER stated that the storage battery scheme suggestion in his paper was simply thrown out as a suggestion with the idea that under certain circumstances it would pay.

PROF. G. D. SHEPARDSON stated that in regard to the effect of outside packing in the eating out of pipes, it might be of interest to the street railway people to know that electrolytic action is not the sole or often the probable cause of this condition. He had no doubt a great deal of trouble attributed to return currents of street railways was really due to chemical action in whatever surrounded the pipe rather than

to electrolytic action pure and simple. He cited such a case as occurring in the Minneapolis City Hall.

A paper was then read by PROF. G. D. SHEPARDSON, of the University of Minnesota, on "220-Volt Lamps."[2]

During the course of the reading of his paper Prof. Shepardson called attention to some curves of tests of 220-volt lamps made by his students. One sheet was made up from the averages of the five lamps of each of four different makes. The initial candle-power varied at the start from 13.6 candle-power, the average of one lot of lamps to 19.8 as the average of another lot. But all these lamps were marked 16 candle-power and were tested at the voltage for which they were marked. The good lamps started at an average of 4.6 watts per candle and, going up to 4.45 in 30 hours, then increased to 4.8 in 90 hours and 4.94 watts per candle in 921 hours. The 10 watts per candle lamp would probably have lasted 6,000 hours if it had been kept going. (Laughter.)

PROF. SHEPARDSON, in reply to a question, stated every one of the municipal plants that he knew of personally had water-works in connection with them—that is, in the same building, and he did not think, therefore, that the figures were worth the ink they are written with. There was nothing allowed for interest or depreciation.

MR. McGILL.—Our company (Siemens & Halske) are pioneers in the use of the 220-volt system, but they have never compared the two systems. They claim that the 220-volt system is more economical than the alternating system under certain circumstances and conditions. It is cleaer, moreover, that for a distance of not more than 1,000 feet the 110-volt system is preferable. But there is no comparison to be made between the 110-volt system and the 220-volt system for distances of 3,000 or 4,000 feet. Capt. Richardson, in Fort Wayne, Ind., went into a detailed investigation to determine whether the alternating system, the 220-volt or the 110-volt system was best to be used in the new court house in that city, and finally the 220-volt system was decided upon. But I do not think you should compare the 220-volt lamp with the 110-volt lamp, and I myself think the 110-volt system is a more economical one.

After further discussion by Prof. Shepardson and Mr. Doherty the convention adjourned until the next day.

THURSDAY, JULY 22.—MORNING SESSION.

The convention was called to order and then went into executive session. The Committee on Legislation presented its report, which was accepted.

MR. DEE moved that the secretary be instructed to confer with the secretary of the National Electric Light Association as to what action the two associations would take with regard to making a report on municipal ownership to the Bureau of Statistics at Washington. Carried.

Adjourned to 2 P. M.

THURSDAY AFTERNOON SESSION.

The secretary stated that he had received some correspondence in the matter of telephone membership; so far as he understood the scope of the association it was only too glad to welcome any one connected in any way with any electrical industry, which would also cover electric railway plants in the Northwest.

A rising vote of thanks was extended to Mr. F. A. Copeland, of La Crosse, for the beautiful badge presented to each member and for the pleasant entertainment arranged by him.

It was decided that the price of the association's central station pamphlet be hereafter made one dollar.

A paper on "The Constant Potential Arc," by O. M. Rau and F. A. Vaughn, was then read by the secretary.

MR. R. F. SCHUCHARDT then read a paper, entitled "The Meters of To-day."

At the conclusion of the reading of his paper, Mr. Schuchardt showed a design of a meter testing rack, made by Mr. Judd, and gave the results of tests on several makes of meter. The paper was discussed by Mr. Thayer.

THE PRESIDENT then appointed as Committee of Entertainment for the next meeting Messrs. H. L. Doherty, W. L. Church and L. B. Caswell, Jr.; as special Committee for Municipal Subjects, Col. W. W. Bean, J. R. Dee and A. A. Cross.

After various votes of thanks for courtesies extended, the convention adjourned sine die.

CONVENTION NOTES.

ON TUESDAY NIGHT the 10:15 train left the Chicago & Northwestern depot with special sleeper attached, in which the Chicago contingent traveled to La Crosse.

WHEN THE WEDNESDAY afternoon session concluded all the visitors repaired to the Fair Grounds, where some bicycle races took place. Among the contestants in the first event were James Wolff, T. J. McGill, F. McMaster, J. D. McIntyre, J. V. S. Church, G. B. Foster and two local men, Otto Langstadt and Philip Linker. The judges of the meeting being unaware of Linker's racing qaulities, gave him only a short handicap; and all the others started even. Linker came in an easy winner, with Langstadt, the other local man, second. The prize for this race was a handsome acetylene lamp.

In the second heat C. Schuchardt was made to go around the track alone to equalize matters. He finished first in the heat, with Foster second, and received a pair of bicycle hose.

While the contestants were having a rest a Fat Man's Race was gotten up, in which James Wolff, Thomas Ferris and C. H. Pearce, all stalwart representatives of the States of Illinois, Wisconsin and Michigan, competed for the honor of riding first to the winning post. Pearce, the Michigan man, although top weight and weighing 260 pounds, led nearly all through, and won easily, with Wolff second. Next came a slow race, which was won by T. J. McGill, who also won the following heat, with F. McMaster close in his wake. This ended the racing and the visitors returned to town.

AT 7:15 WEDNESDAY EVENING the visitors boarded a trolley and two trailer cars, which were handsomely decorated, and made an enjoyable trip to North La Crosse; on the return journey stoppages were made at the street railway power house, and the Brush and Edison lighting plants, all of which were inspected. The cars then took the visitors to the Germania Hall, where they were most agreeably entertained by the Deutscher Verein. Mayor McCord was introduced by Col. Copeland and made an address of welcome to the visitors present. This was followed by an address by Secretary Mercein, and some of the visitors, including George Cutter, F. L. Perry and others. Fine vocal and instrumental selections were rendered by J. R. Kerr and Langstadt's orchestra.

ON THURSDAY AFTERNOON about a dozen private steam and gasoline launches, led by Col. Copeland's Neche, proceeded up the Mississippi River for about six miles until Eagle Point bluff, on the opposite Minnesota shore, was reached, where the party disembarked; then the visitors feasted their eyes on the beautiful scenery which lay before them on all sides. After viewing the surroundings the party sat down and partook of a very plentiful supper most hospitably provided by Col. Copeland. When supper was over, Mr. Thomas Mercein acted as toast master in his usual inimitable style and called upon several of those present to speak. Among those who responded were Messrs. Woodward and Hogan, of La Crosse; W. W. Low, James Wolff, F. L. Perry, W. W. Bean and George Cutter. About 7:30 the party boarded the launches for the return trip, which was made very rapidly as a four-mile current was running down the river. The squadron were saluted by fireworks and gun firing from several of the summer cottages situated on the west bank of the river. La Crosse was reached about 8 o'clock and before leaving the city cheers were given by the visitors for Col. Copeland and the Entertainment Committee.

THE HANDSOME SOUVENIR presented to the visitors by Col. Copeland at Wednesday's meeting was greatly admired and will be kept as a memento of the pleasant time enjoyed by the visitors to La Crosse.

EXHIBIT NOTES.

J. HOLT GATES & CO., of Chicago, were very ably represented by Mr. George B. Foster, who has recently become associated with that concern. Mr. Foster had a strict eye to business and reminded those present that the Wagner, Walker and Card companies were thoroughly up-to-date concerns.

THE ELECTRICAL PRESS had the following representatives on hand: "Western Electrician," F. L. Perry; "Electrical Review," Carl Kammeyer; "Electrical World," J. V. S. Church; The Electrical Engineer, W. P. Sullivan; "American Electrician," W. R. C. Smith; "Electrical Engineering," Fred. De Land.

THE CHICAGO GENERAL FIXTURE COMPANY had their popular representative, Mr. L. W. Kittman, around, who showed that he was thoroughly well able to combine business with pleasure on the occasion.

MR. GEORGE CUTTER, of Chicago, was also in attendance and, with his usual obliging way, looked after the transportation arrangements for the Chicago contingent, and saw that their personal comforts were attended to.

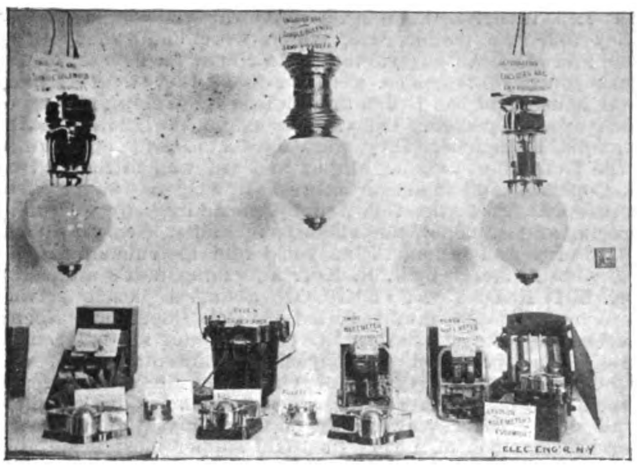
MR. JOSEPH M. HILL, Western manager of the Bryan-Marsh Company, was to the fore and renewed acquaintances with several of his old friends in the Northwest.

THE WASHBURN & MOEN MANUFACTURING COMPANY were well represented by their St. Paul agent, Mr. J. D. Gille, who presented those who attended with a most complete pocket handbook which had a fund of information relating to copper and iron wire, and other very useful matters connected with the trade.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., showed a very nice line of their porcelain special-

ties, including main and branch blocks, tubes, cleats and rosettes. All who saw their one-way plug cut-out were greatly pleased with it. This block is made in the single, double and triple style. The Peru Company also manufacture the well known Laclede battery. Mr. F. D. Covington, who has been with this concern for several years and represented them at the convention, states that he has not yet met with any of his customers who has had any fault to find with their goods.

THE GENERAL ELECTRIC COMPANY had a very representative exhibit, under the care of Messrs. F. N. Boyer and R. A. Swain, of the Chicago office, and Thomas Ferris, their Wisconsin representative. The exhibit comprised a full line of testing instruments for station switchboard, portable and pocket use. These instruments are of the well known inclined astatic type and are adjusted for any voltage or amperage. The portable wattmeter has given exceptional satisfaction after severe testing. A 600-watt type H transformer was shown,



General Electric Co.'s Exhibit.

having a unique arrangement for connecting the primary and secondary leads. This transformer is now so well known that it is not necessary to make any comments on its efficiency.

The company's meter display was very complete and represented the full line from two-wire 50 and 100-volt, to 220-volt three-wire for direct current systems. The arc meters were in evidence, both for station and store work. A new street car meter was shown for a 500-volt system. It places street railway managers in possession of data that heretofore could only be approximated.

The G. E. arc lamp display included some new features. The enclosed long burning arc lamp for alternating currents is giving excellent satisfaction, and appears to have solved the problem of producing a noiseless arc lamp for these circuits; it can be adjusted to any frequency or voltage. The other lamps on exhibition were the 80-volt single solenoid enclosed arc lamp, which can be adjusted for three or five amperes. One of the newest types of Wirt lightning arresters was also shown.

THE CENTRAL ELECTRIC COMPANY, Chicago, had on hand a full line of overhead and other street railway material; also the well known Billings & Spencer drop forged commutator segments, Bound Brook trolley wheel bushings and the Central Clincher ear. The last mentioned specialty has some unique features, as it is so constructed that the edges have only to be hammered a little toward each other and the trolley wire in groove will remain fixed securely in its place, without any soldering. They also showed the Syracuse changeable electric headlight and had some Lundell fans which they handle in operation, and the breezes which they wafted around the gallery of the city hall were extremely refreshing. The Central Co. were very worthily represented by Mr. C. G. Burton and W. P. Upham.

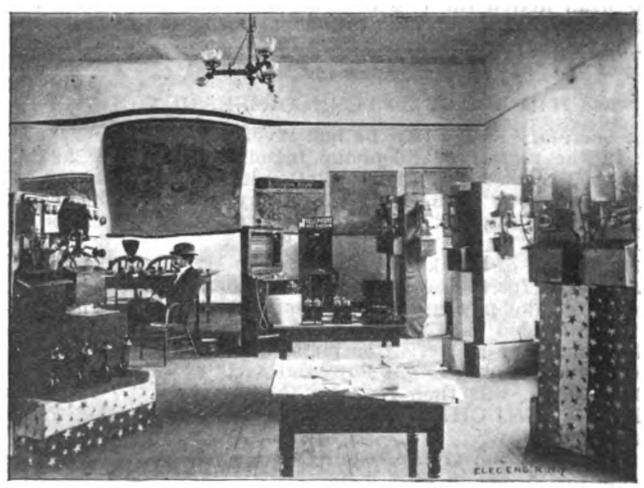
PASS & SEYMOUR, of Syracuse, N. Y., had a line of some of their porcelain specialties, including cleats, rosettes, branch blocks with fuse in cap, china key and keyless sockets, and also their porcelain junction box for primary circuits. This box, which has several new features, attracted considerable attention. Mr. J. D. McIntyre was in charge.

THE ELECTRIC APPLIANCE COMPANY, Chicago, had on view a line of Packard incandescent lamps, Highland's soldering paste, sample boxes of which were distributed among the visitors. Also a line of electrical heating goods manufactured by the American Electrical Heater Company, of Detroit, including smoothing and soldering irons. Several of the visitors who had their tiles or straw hats crushed had only to hand them to Mr. Frank McMaster, one of the representatives of the company, who ironed them over in first class laundry style. A most interesting feature of this exhibit was one of Newgard's waterproof globes, in which was enclosed a lighted incandescent lamp, the outer globe being totally immersed in water during the two days of the convention, without any of the liquid penetrating to the lamp. The genial president, Mr. W. W. Low, was, of course, present, as a function of the kind would not be complete if he were absent, and he was also one of the two fortunate recipients of titular honors conferred on the eventful occasion upon a pair of Chicago's most esteemed citizens.

THE AMERICAN ELECTRIC HEATING CORPORATION, of Boston, were represented by their Chicago manager, Mr. F. P. Luther, who had on view an extensive line of the goods made by this company, among which were 4 and 6-pound flat irons for laundry work; five o'clock tea kettles, kettles for boiling cereal foods; disc stoves, stew pans; an electric heating pad to take the place of hot water bottles, an electric immersion coil, which will do any cooking that a steam coil will do, and also one of their new Universal enamel rheostats, which they claim to be the best thing of the kind on the market at the present time.

THE ELECTRICAL SUPPLY COMPANY, of Madison, Wis., had a full line of supplies, special attention being paid to Columbia incandescent lamps, Grimshaw, Raven core, and rubberite wires, American tubes and insulators, Standard telephone and telephone supplies and sundries. Mr. L. W. Burch, the energetic president of the company, was around talking supplies, and helping to make things generally lively, in which attempt he was ably assisted by Mr. L. C. Hackney.

AMERICAN ELECTRIC TELEPHONE COMPANY.—To the regular attendants at the electric light conventions the size and handsome appearance of the exhibit of the American Electric Telephone Company, of Chicago, was undoubtedly a surprise from the fact that hitherto the telephone manufacturing companies do not appear to have thought it quite necessary for them to pay much attention to the conventions where central station men assemble. It would appear from the amount of telephone apparatus which the American Company showed at the convention that they were perfectly cognizant of the fact that lighting conventions were worth being attended by the telephone manufacturers. Among the large variety of telephone apparatus shown was that of the combined district and messenger system, which had not been exhibited before. The American Company has lately secured control and made arrangements for its adoption by the



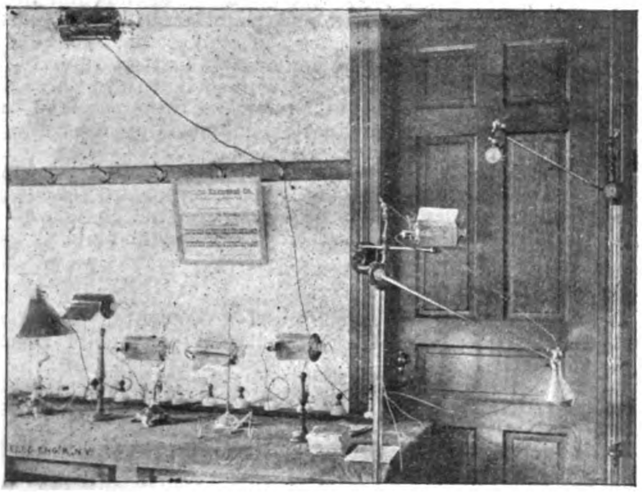
American Electric Telephone Mfg. Co.'s Exhibit.

city of Pittsburg and other towns. There was a display of about one dozen different types of telephones, and the cabinet work was quite varied. There were also two new types of portable desk sets, an elaborate sound-proof telephone booth, and among the other novelties shown were the new adjustable transmitter arm, new combined fuse and carbon lightning arrester, "express" type switchboard with automatic ringing device, automatic drop restoring feature, a new departure in the way of trunk line system for use in large exchanges; large magneto generator, and sundry other specialties in the telephone line. President P. C. Burns and Manager H. C. Dodge were indefatigable in their attentions to the numerous visitors to their fine exhibit.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, was represented at the convention by Mr.

Eugene H. Abadie, who, with his usual courtesy, took pains to describe the different electrical appliances which they had on exhibition. These included a direct and alternating current motor, an alternating current ceiling fan motor, which was hung over their exhibit and served materially to keep cool the large room in which the exhibit was located. They also showed a line of switches, transformers and station instruments. Each visitor to the exhibit was presented with a neat souvenir button on which was shown a front view of the company's factory at St. Louis.

THE PACIFIC ELECTRIC COMPANY, La Crosse, Wis., had a full line, consisting of about ten different styles of the Espersen adjustable shade lamps; they also showed the Espersen dental and surgical lamps, and the Espersen eye, ear,



PACIFIC ELECTRIC CO.'S EXHIBIT

nose and throat lamps for medical examination. This company's shade lamps are noted for their ease of adjustability and simplicity of mechanical construction. This company is also prepared to furnish these lamps in different styles of finish and color to match the furnishings and surroundings of a room. The Ericson automatic bicycle bell is also manufactured by this company. Messrs. Haskell, Withee and Arthur F. Espersen had charge of the exhibit of this company.

MR. CHARLES C. SCHUMACHER and MR. ALBERT ZAMEL, of Chicago, were on hand and showed one of the new Zamel arc light meters and electric current timers. This instrument is a simple device, consisting of a balance wheel on a shaft on which is also placed a cog wheel, which works a toothed lever that serves to start and stop the clockwork movement which registers the length of time during which the arc lights are being used. The front of the instrument has a face similar to a clock's on which are shown the number of hours that the lights are in operation. All parts of the instrument are mounted on slate and perfectly insulated.

THE NEW YORK INSULATED WIRE COMPANY were represented by their genial Western manager, Mr. James Wolff, who was indefatigable in his efforts to assist in making the convention meeting successful, and at the same time had a sharp eye to business. Mr. Wolff had the good fortune to have a titular honor conferred upon him, together with the worthy president of a large Chicago supply house, and it is greatly to the credit of these two gentlemen that they received their honors with that innate modesty which is so thoroughly inbred in both.

IT was a matter of regret that one of the old representatives of the Fort Wayne Electric Corporation, who have been in the habit of attending these Northwestern conventions, did not get to La Crosse, but this company selected a very good substitute when they sent Mr. E. F. Kirkpatrick, of their Chicago office, to look after their interests.

THE PEOPLE'S ELECTRIC COMPANY, of Madison, Wis., was very ably represented by President F. H. Ford and Secretary C. W. Bacon, who were most energetically engaged in pushing for business for their progressive concern, and at the same time participated heartily in the entertainment features of the occasion.

THE LESHER-MACOMBER-WHYTE COMPANY, Chicago, had their Mr. George S. Whyte on hand. Mr. Whyte's abilities as a business man or as an entertainer with stories or song are too well known in the West to require any further comment; suffice it to say that he acquitted himself on this occasion with his usual success.

THE SIEMENS & HALSKE ELECTRIC COMPANY were represented by Mr. T. Julian McGill, who was very actively engaged in attending to the interests of the company, and made quite a number of friends at the convention.

THE CARBON manufacturing companies were well represented and had the following present: National Carbon Company, Cleveland, M. L. Stevenson, Chicago and Northwestern agent;

Standard Carbon Company, Cleveland, W. O. Connor; Crouse-Tremaine Carbon Company, Fostoria, O., J. S. Maurer.

There were also in attendance the following: Herman Andrae, Julius Andrae & Sons, Milwaukee; W. D. McDonald and W. F. Benton, Benton & McDonald, La Crosse; C. A. Ross, Sawyer-Man Company, Chicago; R. N. Loper, New Haven Car Register Company, New Haven, Conn.; B. E. Edwards, president La Crosse Electric Railway Company; James J. Hogan, president La Crosse C. B. E. L. & P. Company.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, were represented by their Chicago manager, Mr. J. H. Cooke, who showed a full line of incandescent lamps, manufactured by this concern. Mr. Cooke also had on hand some handsome arc lamps for various systems, manufactured by the Jandus Electric Company, Cleveland, Ohio. Of the type of lamp used on the direct current system more than 17,000 are now in daily service, and nearly all the Edison central stations throughout the country use the Jandus lamp exclusively.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY exhibited a 5 horse-power, 220-volt shunt wound, slow speed multipolar motor, which was shown in operation, and attracted considerable attention. They also showed an alternating constant potential 15-ampere, 26-volt arc lamp, which operates from an economy coil for an incandescent circuit. It is of an ornamental design, and is suitable for lighting stores, buildings or residences. They also had on hand an automatic circuit breaker for protecting direct current circuits; also Wurts's lightning arresters, ampere and wattmeters, transformers and fuse boxes. Mr. Henry Floy had charge of the exhibit.

THE COLUMBIA INCANDESCENT LAMP COMPANY, of St. Louis, were represented by Mr. A. C. Garrison, and had samples of some of their make of lamps, and also showed specimens of the liquid used in making filaments, as well as samples of threads, and the manufactured filaments. Mr. Garrison also gave souvenir buttons on which were shown a picture of one of their makes of lamps.

FOURTEENTH MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AT GREENACRE, ME.

FIRST DAY.

THE fourteenth general meeting of the American Institute of Electrical Engineers was held at Greenacre-on-the-Piscataqua, near Eliot, Me., on July 26, 27 and 28, under unusually interesting circumstances, the society having accepted the invitation of Miss Sarah J. Farmer to visit Greenacre and assist at the jubilee of the electrical work of her distinguished father, Prof. Moses G. Farmer, whose first electrical undertaking, a short electric exhibition road, was put in operation at Dover, N. H., just fifty years ago. Owing to the remoteness of the spot, from most electrical centers, it was not expected that the attendance would be large, but it was believed by the Institute Council that the occasion was peculiarly one at which it should be represented. Prof. Farmer was a charter member, and afterward an honorary member, and took deep interest in the growth of the Institute. Its earlier existence would probably have led to the publication of many of his researches, which, for lack of such a channel of publicity, were allowed to lie in his thickly accumulated notebooks.

The meeting was called to order in the Eirenion Hall, on the Greenacre grounds, at 2 p. m., by Prof. F. B. Crocker, president, when Mr. C. P. Steinmetz presented a highly interesting paper on "The Alternating Current Induction Motor."

This paper gave the results of tests on polyphase induction motors. The paper embodied a series of curves showing the relations of speed, efficiency, power factor, current, output, etc., for a variety of conditions which arise in practice. Mr. Steinmetz discussed these curves and showed what is necessary and what must be avoided to obtain the best results in polyphase induction motors. A table of data on such motors, actually constructed, was included in the paper.

The paper was discussed briefly by Profs. Thomson, Goldsborough, Perrine and Kennelly.

PROF. ELIHU THOMSON then read a paper, entitled "A New Form of Induction Coil." He described a new type employing the principle of a "substitute primary," or "secondary primary," already applied by him in a variety of ways. This coil can be used direct on high potential circuits without the

use of banks of lamps or storage batteries. It is intended more particularly for Röntgen ray work.

The paper was discussed by Messrs. Marks and Kennelly. The regular afternoon session of the Institute then closed.

MONDAY AFTERNOON.

The afternoon was given up to the meeting called in the programme of the Electrical Conference that had been organized by Miss Farmer, to continue during the week of the Institute meeting. The opening session was intended as a memorial to Prof. Farmer, and was held in the large tent on the grounds, when the conference convened under the direction of Prof. Cyrus F. Brackett, of Princeton, who addressed a large audience on the subject of "The Past and Present Outlook of Electrical Science." It was a very able condensation of electrical advance as embodied in scientific history and as expressed in the adoption of succeeding ideas and theories or principles as to the nature and physical relations of electrical phenomena.

PROF. A. E. DOLBEAR, of Tufts' College, followed with an address on "Moses G. Farmer as an Electrical Pioneer."

Prof. Dolbear gave a most graphic review of Mr. Farmer's life and work, and brought out the fact that he combined harmoniously the theoretical and practical sides. He thought with the late F. L. Pope that modern electrical engineering ought to date from the Farmer beginnings, the only predecessor being the Morse telegraph. Indeed, Prof. Dolbear seemed to think that the honors had been distributed very unequally. "Morse, who did nothing electrical, had his front shingled with European decorations and his bronze image sits in Central Park." As to Farmer, "he himself did not herald his inventions. Those who profited by them were content to pocket the receipts and say nothing; and men of science ignored him. First he did not belong to the schools, and, second, it was not thought by them to be proper for a scientific man to patent his inventions. Dartmouth College honored him with an A. M., which is absurd, when a callow graduate can get one by a year of work, which, in itself, amounts to nothing." One trouble with Mr. Farmer was that, unlike Faraday, he did not publish his experimental work, whether with or without result. In the files of Farmer's notebooks, there were not less than 15,000 pages filled with most valuable records and suggestions. So completely did Mr. Farmer cover the electrical field in inventions that almost every one who has applied for a patent for what he took to be some electrical novelty has been referred to Mr. Farmer's prior inventions as embodying it; in spite of which much, as will be seen, was left unknown. Prof. Dolbear, in conclusion, showed how early Farmer did much of his work, and he made the broadest claims for his priority in the lines of fire alarm telegraphy, railway work, quadruplexy, self-exciting dynamos, incandescent lighting, practical thermopiles, torpedo work, and many other fields. The address was received with very hearty and prolonged applause.

MR. W. J. HAMMER, by request, then read a very interesting letter written to him by Prof. Farmer, just before his death in 1893.

MONDAY EVENING.

The evening session of the Institute was held at the Eirenion, which was crowded by members, and Greenacre folk. Miss Farmer made a brief address of welcome and then delegated the task of the formal address to her father's friend, Prof. G. F. Barker, of the University of Pennsylvania, who delivered a charming speech full of reminiscences of Prof. Farmer, extending over a great many years, beginning with the youth of the speaker. Prof. Barker took occasion to emphasize the evidence of the priority of Prof. Farmer's work in regard to the principle of self-excitation.

PROF. CROCKER responded on behalf of the Institute, acknowledging the compliment. He spoke of Prof. Farmer as being in many respects the ideal electrical engineer, combining ability to grasp principles, skill in applying them, in original apparatus, and a thirst for definite data on all things in his field. He then went on to deliver his inaugural address on "The Precision of Electrical Engineering." The address championed electricity as one in regard to which, outside the mystery of its nature, we could get more definite ideas as to its work and effects than of any other agency employed by man. He thought that even if we knew what electricity was, it would make little difference, except, perhaps, in the generation of current. Most of the utilizations would probably remain pretty much the same. He went on to show how wide are the margins and "safety factors" required in other engineering work, and how much of the cut-and-try still remains. In electricity, the largest and smallest apparatus was now closely predetermined within a small percentage, and the calculations made by any competent man would prove sharply precise and accurate. Prof. Crocker instanced a number of striking instances of precalculation, of fine measurement, of close detection of "faults," and other features of precise dealing with the facts and conditions. He referred also to the precision of engineering electrical terms and units, and their universal acceptance, while in other fields a variety of confusing terms and units still existed everywhere. As to the manner in which the present age had developed electrical ideas to the limits, Prof. Crocker said that both Mr. Edison and Mr. Tesla had lately intimated to him that they were more interested in chemistry and in steam engineering because there was more uncertainty, and therefore more chance to improve things than now existed in the arts of electricity.

MR. W. S. KEY, at the close of the address, read by request two letters of Prof. Farmer written at the time of the Dover electric road in 1847, exactly fifty years ago that very night. One letter was to a local poetical celebrity, asking him to get up some verses on the event and bring along his melodeon. The other letter was to Charles Carleton Coffin, speaking of the work on the road, and among family matters referring to Miss Farmer's birth. The letters were delightfully naive and earnest, with many touches of humor, and were received with frequent outbursts of applause. The meeting closed as it opened with excellent music.

A resolution was offered by Mrs. K. T. Woods and seconded by Prof. Thomson that some steps be taken toward founding a permanent memorial of Prof. Farmer, and the chair was instructed to form a committee with that end in view.

TUESDAY MORNING.

DR. A. MACFARLANE'S paper on the "Application of Hyperbolic Analysis to the Discharge of a Condenser" was read, and was discussed by Messrs. Steinmetz, Kennelly, Perrine and Bell.

MESSRS. P. A. BATES and W. C. BARNES then presented in person their paper on the "Effect of Heat upon Insulation."

The paper gave the continuation, as it were, of the experiments made by Messrs. Lever, Monell and Perry, read at the last annual meeting. The results correspond in the main with those previously obtained. It is shown that the presence of brass in the testing apparatus does not affect the results, which depend solely on the amount of moisture and its opportunity of escape. The resistance increases every time it is heated and cooled, provided it is kept from absorbing moisture. Red insulating fiber was used in the experiments.

The paper was quite fully discussed by Messrs. Crocker, Perrine, Estey, Steinmetz, Thomson and Kennelly.

PROF. W. E. GOLDSBOROUGH then read a paper on "The Effect of Armature Inductance upon the Electromotive Force Curves of an Alternator," which was discussed after dinner by Messrs. Dunn and Steinmetz.

In this paper Prof. Goldsborough embodies the results of experiments made with an exploring coil in connection with a 3-light Brush arc machine. The results are plotted in curves which show the voltage obtained at different positions of the exploring coil under varying conditions of current strength, etc.

During the morning session a group photograph was taken at the Eirenion. The original Farmer locomotive and car sent on by the Smithsonian Institution were placed in the center, with Miss Farmer and her father's portrait at the back. On the locomotive was pinned one of the original posters announcing the opening of the road and inviting the public.

TUESDAY AFTERNOON.

MR. C. P. STEINMETZ presided over the afternoon session.

MR. CARYL D. HASKINS read a very interesting paper on "Electrical Metering from the Station Standpoint."

In his paper Mr. Haskins laid down the principal requirements of a good meter. He showed that mere ability to start on a very small load did not make up the sum and substance of a good meter, but that for all-round utility other qualities were necessary and desirable. He gave a number of valuable hints to station operators as to the best method of handling meters, where to look for the meter tamperer's work, etc. He also expressed the belief that the penny-in-the-slot meter had a great future before it.

DR. LOUIS BELL gave an interesting discussion of the paper and expressed his strong belief in the coming prevalence of direct reading meters that would give the watt hours where every user could read and see them, rather than be puzzled by a set of wheels running up a charge against him in some weird and suspicious manner. The paper was also discussed by Messrs. Perrine, Owens and Haskins, along the line of the practical aspects of the question.

The Greenacre Conference in the afternoon listened to a charming address from PROF. G. F. BARKER, on the work of the Philosophical Society. This was followed by a very happy description from MR. A. E. KENNELLY, on the nat-

ure, conditions, successes and perils of submarine cable work. He told graphically of one operation he had been engaged in on the English-Lisbon cable. They were repairing a break and actually had the cable raised and on deck, when desiring to get a few more feet they tried to do so. On a sudden, the cable snapped and slid slowly off the deck, nobody, of course, being able to avert the disaster of losing it again after long toil. A sailor almost instinctively put his hands on it to stop it, but such an effort was obviously useless.

TUESDAY EVENING.

MR. ADAM BOSCH read a paper, entitled "A Historical Sketch of the Fire Alarm Telegraph," and gave in it a very complete review of the advance and growth of that useful system from the time of Farmer and Channing down to the present day.

Discussion was contributed by Prof. Barker and Miss Farmer.

A paper was then read from MR. M. H. GERRY, JR., entitled "Electric Traction: Notes on the Application of Electric Motive Power to Railway Service," with illustrations from the practice of the Metropolitan Elevated Road, of Chicago. In the absence of the author the paper was read by Secretary Pope.

The author traced the various efficiencies of the transforming steps from generator to car axle, and brought out in a striking manner the power required for acceleration of elevated trains, which, in the case of the Metropolitan Road, required 63.9 per cent. of the total power, with only 29.1 per cent. for train resistance and 7 per cent. for grade. Mr. Gerry holds that electricity has well established its claim to economy and adaptability to railroad traffic. The paper was elucidated by numerous curves, showing the behavior of the motors under varying loads, speeds, etc., and also by current diagrams covering an entire trip.

A brisk discussion arose between Messrs. Perrine, Steinmetz, Crocker and Thomson as to the features of accelerating, coasting and retarding a train, and on the distribution of the kinetic energy required to get trains from station to station. Mr. Steinmetz described the new London Central subway road, where to assist acceleration trains will leave stations on a good down grade, will then coast, and have retardation assisted by a good up grade to the short level at the station.

WEDNESDAY MORNING.

Prior to the opening of the morning session, a visit was made by many of the members to the Farmer homestead, at Eliot, about a mile from Greenacre through the pine woods. The quaint, old-fashioned house is not only full of family mementoes and relics of colonial and revolutionary ancestors, but brims over literally with evidences of the ceaseless electrical work and study of Prof. Farmer. Not only did he use three rooms in the house for study and experiment, the traces and signs of which are religiously preserved by his daughter. but there is an annex laboratory in a large barn, chock full of old apparatus, bearing all the earmarks of frequent and various use, and which the large exhibit at the Eirenion did not appear to have at all depleted. Mr. Keefe, who had long served as Prof. Farmer's assistant, and who is now one of the trustees of the estate, was most interesting and helpful in explaining the different pieces and in telling of Prof. Farmer's ideas and plans. Some of the apparatus is going to the Smithsonian Museum at Washington, but it is an open secret that Miss Farmer proposes to entrust some of it to the Institute; to whom it has also been suggested that a volume issued under its direction, composed of Prof. Farmer's most important notes and observations would be as worthy an effort as its publication of the proceedings of the Electrical Congress of 1893. After the trip, the members returned to the Eirenion and the regular sessions began.

MR. HORATIO A. FOSTER presented a paper on "The Cost of Steam Power."

In this paper Mr. Foster embodies the results of an extended investigation covering widely different types of industry and conditions of operation. He tabulates and discusses in detail twenty-two plants investigated, varying from 12 h. p. up to 2,422 h. p. in capacity. The variations of cost shown are very great, even in plants of the same general type, so that it is almost impossible to generalize. Taking large compound condensing engines, however, he finds the cost to be $.00824 per h. p. hour. The average of other investigators of repute is $.00705. The paper was replete with valuable data on the cost of steam power and what ought to be included in such an estimate. A diagram included in the paper, due to Mr. L. B. Stillwell, showed the cost per h. p. for any given case.

PROF. PERRINE made the point that the best fuel is that which yields the cheapest steam, and he gave an interesting account of fuels on the Pacific Coast.

PROF. THOMAS said that the best recent work in this line was a paper by Prof. Lord, read before the Mining Engineers, and not yet out. It would be found thoroughly exhaustive and very useful.

MR. POPE called attention to the economies in fuel now effected, as shown by the fact that pea coal and others now on the market were utterly neglected as waste a few years ago.

PROF. OWENS said the best way to get at it was to figure out the pounds of water evaporated for every dollar's worth of coal. He pointed also to the high relative importance of lamp breakage, as an item comparing against fuel outlay.

MR. BURNETT as a central station man approved the high value of the Foster data.

MR. RIPLEY told of a practical experience on Long Island where an engineer wanting to burn coal of high calorific value had lots of trouble with his directors because of the apparent high price.

PROF. OWENS as special commissioner from the State of Nebraska invited the society to hold its next meeting in 1898 at Omaha, during the continuance of the Trans-Mississippi Exposition there.

MR. MARTIN urged strongly the going West, and pointed to the remarkably liberal expenditure of Nebraska in education and for technical training. This should be recognized and encouraged. He offered the following, which was forcibly seconded by Mr. G. S. Dunn, and supported by Messrs. Steinmetz and Pike, while Mr. Pope mentioned that the Institute had received other invitations:

"Resolved, That it is the sense of this meeting that it is desirable to hold the next general meeting of the Institute at Omaha, and that the invitation extended by Prof. Owens be favorably referred to the Council for further consideration and early action." The resolution was unanimously adopted.

PRESIDENT CROCKER made an informal report of the successful adoption by the National Conference on the subject, of which he was a member, of the National Code of Wiring Rules. After a discussion as to the propriety of anticipating the acceptance and approval of the Rules by the Council, the meeting voted not to take any action of its own on the matter other than the presentation to it of Prof. Crocker's report.

MR. W. H. FREEDMAN'S paper on "Efficiency and Life of Carbons in Enclosed Arc Lamps" was then presented.

The author and his assistants tested seven different makes of enclosed lamps as to regulation of arc, life of carbons, candle-power, etc., and find that the enclosed lamp has the following advantages over the open arc: Long life and consequent saving in carbon, trimming expenses, etc.; pleasant light, freedom from hissing; absence of flying dust and sparks; no danger from high potentials, and no need of automatic cut-out; simplicity of mechanism.

Mr. Freedman's paper was discussed by Messrs. Kennelly, Owens, Crocker, Marks, Spaulding, Steinmetz and Rittenhouse. The session then adjourned.

During the morning session a special dispatch of 300 or 400 words to Miss Farmer of congratulation from Mr. Frank J. Sprague was read by the recipient. Mr. Sprague, who was at Schenectady testing his new system of electric traction, described elsewhere in this issue, and who was an old friend and Newport naval student under Prof. Farmer, said he was glad to associate his work with that of the pioneer under such auspicious circumstances.

PROF. R. B. OWENS then read an interesting paper, entitled "Armature Reactions in a Rotary Transformer." He pointed out that the increasing use of rotary converters in power distribution makes it necessary that all points relating to their design be studied with the same care and exactness that standard forms of alternating and direct current apparatus have received. It has been known that the armature reactions in rotary converters are comparatively small, but exact quantitative measurements have been wanting. In the paper presented by Prof. Owens, the exact instantaneous distribution of induction over the pole faces of a rotary converter under different conditions of loading and different armature positions is plotted as a series of curves, which show in an exceptionally clear manner the shifting of induction in amount and direction as the armature rotates. Curves were also given showing the armature reactions of the machine operating as a simple direct current motor; comparing which with the curves of instantaneous induction distribution when operating as a conoverter the relative amount of armature reaction of the same machine operating in the two ways is clearly shown. The data obtained will be of use in many ways. The general method employed to measure instantaneous induction values was by measuring the instantaneous e. m. f.'s generated in a series of equal evenly spaced test coils of fine wire wound over the armature surface. The contact maker is especially good. The zero telephone method was used in

measuring e. m. f.'s, which allowed of accurate measurement of 1-50 volt.

The Owens paper was discussed by Messrs. Crocker, Goldsborough, Dunn, Steinmetz and Elihu Thomson.

Before the work of the convention closed, a committee, composed of Messrs. Pope, Crocker and Owens, was appointed to draw up resolutions thanking Miss Farmer for her kindness and hospitality.

AFTERNOON AND EVENING SESSION.

At the afternoon meeting of the Greenacre Conference, Dr. F. A. C. Perrine gave a very suggestive address on "The Altruistic Aspects of Electricity." He pointed out that electricity was a vital factor in social economy and economies, and that all the aims of electricians were directed toward improving apparatus and lessening costs. Thus, they were constantly bettering things all around them. The value of electric light in lessening vice and crime outdoors, and in ameliorating conditions indoors, especially in workshops, was alluded to, and it was also noted that a further hygienic gain came in from the resort to electricity in chemical manufactures. In the uses of electrical power many beneficial social changes were also found, ranging from the diminution of smoke to the reduction of bad elements in the factory system.

PROF. ELIHU THOMSON at the evening Conference gave an address, with wonted charm and felicity, on "The Future of Electricity." Like Prof. Brackett, he is not to be counted among the pessimists who think that the possibilities of electrical development are used up.

PROF. F. P. JACKSON'S paper was the last on the Institute programme, and was entitled "The Economy and Utility of Electrical Cooking Apparatus." He made comparative tests of the cost of cooking and ironing for a family of six for several weeks. Taking the cost per k. w. hour at 10 cents and coal at $5 per ton, he finds that cooking by coal costs about 19 per cent. of that by electricity. Ironing by coal cost 54 per cent. of that by electricity. The results seem to indicate that ordinarily the cost of electric cooking would be prohibitory; but there are many situations in which countervailing advantages would make electric cooking desirable.

The Jackson paper was discussed by Messrs. Thomson, Owens and Pope.

CONVENTION NOTES.

A very interesting exhibit was made of some 400 or 500 photographs, framed and unframed, relative to electric railway work, and loaned for the occasion by the General Electric Company, the Walker Manufacturing Company, the Westinghouse Electric and Manufacturing Company, the "Street Railway Journal," The Electrical Engineer, Prof. Elihu Thomson, Prof. S. H. Short, Mr. W. J. Hammer, Mr. T. C. Martin and others. These were displayed on long tables and on the walls, and were carefully labeled with explanatory references so as to be readily understood. They showed the whole range of the art during the last ten years of rapid commercial development, and were representative of roads and apparatus in all parts of the world. Portraits were also shown of men active in the work. This photographic exhibit was supplemented by a beautiful collection of electrical portraits, loaned by Mr. Hammer, and including also some of his data and relics relative to Prof. Farmer. The exhibit and that of Prof. Farmer's papers and apparatus were in charge of Messrs. Key, Keefe, Martin and Hammer.

The Farmer collection was extremely interesting and comprised a large variety of experimental and perfected apparatus, chiefly from the Farmer laboratory at Eliot. It was necessarily far from complete, but gave a good idea of the inventor's range and versatility, including telegraphs, motors, generators, thermopiles, fire alarms, torpedo apparatus, batteries, measuring instruments, etc. With this were shown many relics, autographs, photographs, biographical articles, and two excellent oil portraits of Prof. Farmer and his wife.

The attendance while naturally small of those directly interested was highly representative, and all parts of the country were included. Among those present were W. C. Andrews, Dr. Louis Bell, C. T. Bancroft, Prof. C. F. Brackett, Princeton University; Putnam A. Bates, Adam Bosch, D. Burnett, R. G. Brown, Prof. G. F. Barker, University of Pennsylvania; J. H. Craig, C. T. Childs, A. E. Childs, Prof. F. B Crocker, Columbia University, N. Y.; G. A. Damon, G. S. Dunn, Prof. A. E. Dolbear, Tufts' College; Prof. W. Estey, Urbana; C. L. Edgar, Prof. W. E. Goldsborough, Lafayette University, Ind.; F. W. Hadley, Caryl D. Haskins, G. A. Hamilton, W. J. Johnston, W. S. Key, Francis Keefe, T. C. Martin, L. B. Marks, Prof. R. B. Owens, University of Nebraska; N. W. Perry, Clayton W. Pike, Prof. F. A. C. Perrine, Leland Stanford, Jr., University, California; R. W. Ryan, Almon Robinson, C. T. Rittenhouse, W. H. Ripley, C. P. Steinmetz, C. K. Stearns, H. C. Spaulding, Prof. Elihu Thomson, H. Wray Weller, W. D. Weaver. Some of those present were accompanied by members of their family, and there were, of course, a large number in attendance at the Institute meetings and the Conferences from the resident population of Eliot, Me., and from those sojourning at Greenacre for the studies and recreations of the season.

Nothing could have been more agreeably enthusiastic than the reception accorded the Institute at Greenacre by Miss Farmer and her friends. The Inn being unable to accommodate all, Mrs. Ole Bull received several into her cottage, while others went out into tents in breezy Sunrise Camp. The weather was fine as a general thing, and the pleasure of the occasion was thus greatly enhanced. There were several local committees of ladies to attend to various matters, and the work of those who assumed secretarial duties must be specially commended.

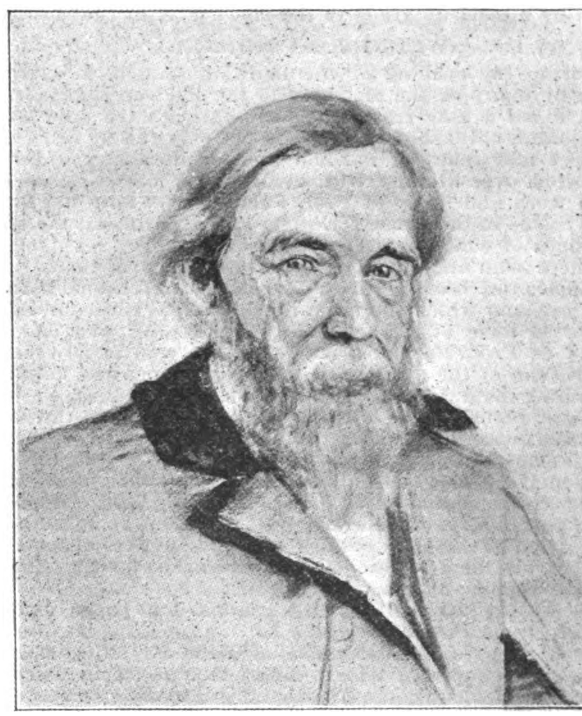
The committee selected to take in hand the Farmer Memorial consists of Mrs. Ole Bull, Mrs. Kate Tannott Woods, Prof. G. F. Barker, Prof. A. E. Dolbear and Prof. Elihu Thomson. Nothing definite has been chosen yet, but a scholarship is seriously under consideration.

PERSONAL

PROF. MOSES G. FARMER.

A detailed sketch of Prof. Farmer, whose electric railway jubilee was celebrated at Greenacre, Me., last week, was given with portrait, by Mr. Franklin L. Pope, in The Electrical Engineer of May 31 and June 7, 1893, and need not be here gone into as elaborately.

The life work of Prof. Farmer was admirably summed up by Prof. Dolbear, at Greenacre, in his memorial address. At 26 he had built an electrical railroad. At 28 he had improved the telegraph. At 30 he had invented and constructed his fire alarm system with water-power driven dynamos. At 35 he had discovered the means for duplex and quadruple telegraphs. At 36 he invented the art of depositing aluminum electrolytically. At 39 he lit his parlor in Salem with incandescent lamps. At 44 he had greatly improved thermo-electric generators. At 46 he had been the first to invent the modern dynamo with self-exciting field. At 48 he lit a house, in Cambridge, Mass., with 40 incandescent lamps in multiple cir-



PROF. MOSES G. FARMER.

cuit, and all properly self-regulating. Prof. Dolbear thought also that there was good reason for believing that he was to be credited with the introduction of the condenser into telegraph

Miss Sarah J. Farmer.

work. We supplement our portrait of Prof. Farmer with one of his public spirited and philanthropic daughter.

NEWS AND NOTES

THE NEW SPRAGUE MULTIPLE UNIT SYSTEM OF CAR TRACTION.

An important demonstration in electric railway work was made at Schenectady, on the experimental track of the General Electric Company, on July 26, when a number of prominent railroad men met to watch the test of Mr. Frank J. Sprague's new multiple unit system of electric car propulsion.

The keynote of this system is the individualizing of cars in all details. Its object is to so control them that they can be connected together at will, and, when so connected, operated from either end of any car in the train unit. It thus stands in broad contrast to the two systems hitherto in vogue, the individual car equipment, as in ordinary street service, which had its precursor at Richmond, and the locomotive car equipment, pulling trail cars. The last is represented on the Nantasket line, the Metropolitan West Side and Lake Shore Elevated Railroad, at Chicago, and, with the difference that steam is used instead of electricity, is in use on the elevated roads throughout the country.

It is a curious fact that prior to the inauguration of the present trolley system, in 1886 and 1887, there was built for the Sprague Company a car, which was designed to be operated as a locomotive car. It was a full-sized elevated railroad car having double trucks, 42-inch wheels, inverted half-elliptic spring suspensions, with enclosed vestibules at each end, for the motorman, and a central smoking cab. This car was to have been equipped with four 75 h. p. motors, but it was never finished. It was before its time. It afterward passed into the hands of the General Electric Company, and was kept in the yard at Schenectady. This car has since been fitted with motors, and used for traction experiments on the G. E. private track. By a singular coincidence, the new Sprague equipment has been delivered on the tracks alongside of it, eleven years after its too early evolution.

The experimental train consisted of six standard cars of the South Side Elevated Railroad, Chicago, each of which had at one end a McGuire truck carrying two "New 57" G. E. motors, of a normal capacity, of 50 h. p. each, and tested to over 100 h. p. The cars were all equipped with the new Sprague multiple unit system of control, by which any car is operated from either end by a lever or push button, with automatic return, something after the method of the Sprague elevator. The details of this system have not yet been made public, but the results obtained are interesting. By its application, any number of cars, without regard to sequence or heading, may be coupled together, and, when so coupled, instantly controlled from either selected end of any car.

Controlling mechanism is carried on five cars enclosed underneath the seat inside the car. In one car it occupies the unique position of a space inside the canopy over the platform, where it can be reached by an inspector without entering the car. Underneath each car is a small cable terminating in a flexible end, with a peculiar interlocking coupling, which, no matter what the heading of the cars may be, so connects the controlling circuits, that the same directional movement of the controller on the platform always produces the same movement of the car with regard to the track. There is, therefore, no such thing as a head or tail of the car. The establishment of this coupling takes less time than the coupling of a single pipe in the ordinary air-brake system.

The visible controlling agency on the platform consists of a round box, carried on an upright, on the face of which is a movable lever, which turns in one direction or the other, and through various degrees of arc. It also, according to the time of contact on certain sections of the arc, gives the forward and backward movements, and all variations of speed. Whenever the power is on the machine, the operator who wishes to put the car in motion, must at all times retain his hold of the controlling lever. If he lets go the controlling apparatus is immediately brought to the position of "off," and the power is cut off from the car. The action of this controller on the regulators of all the cars is instantaneous. It matters not whether the operator is standing in the middle of the train or at the end, there is a simultaneous movement of the regulators in each car through all the gradations of control. Each train is also equipped with a circuit breaker, and an automatic air compressor. It is electrically lighted and will be electrically heated.

A special feature, illustrated in one car, is the new Sprague vestibule, an admirably effective and convenient arrangement, in which all the perplexing problems of the car vestibule appear to be easily and simply solved. It enables the operator on any ordinary platform to be enclosed, either wholly or in part, and gives him full view of the track both forward and backward along the train. He is at the same time within reach of his controller, air and hand brakes, and air gauge. When he leaves the vestibule, the platform can be immediately thrown open to serve for the exit or entrance of passengers.

The braking of the train is accomplished by the Westinghouse automatic air-brake, with an engineer's valve on each platform, closed by the motor regulators, and with air supplied by Standard automatic air compressors.

The action of the controller is remarkable. There is little, if any, more apparatus than on the standard street car, yet the extra hands, which are usually engaged in operating two or more such cars, coupled together, are replaced, under the new system, by an exceedingly ingenious mechanism. These automatic, electrical mechanisms are controlled at will or automatically by the motorman at the head of the train, each, however, exercising over its own motors an automatic supervision of such a character that it will not permit stupidity or carelessness on the part of an operator.

When the system, which is the fruition of prophecies made by Mr. Sprague, and which have been indicated from time to time by him, was proposed, much doubt was expressed as to whether a number of individual controls joined together would be sufficiently similar in operation to equalize, for all practical purposes the circuit on the various motors. Practice has shown that by novel automatic regulation each motor very largely takes care of itself in this respect, or, at least, makes its own controller do it, and it is found that practically equal duty is exercised at all speeds and loads by the motors on the different cars. To such an extent does this obtain, that although the operator has the privilege to retard acceleration, he is limited in his extent of it, and at will can, no matter what the load, make the motors throughout the

system each accelerate at its safe maximum by a single movement of the platform lever. In case of serious trouble to a machine, such as short-circuit or burn-out, the motors on that part of the cars will cut themselves out automatically, and the cars can be pulled along by the remaining cars of the system.

The controllers, also, are self-rectifying, inasmuch as, should the line current fail and then be restored, they will come back to the starting position before the circuit can be closed through the machines.

The practical possibilities of the system seem to be many. Suburban and elevated service, the latter particularly, where there is any attempt at high schedule speed, with frequent stops, is largely a problem of acceleration, the car being got out of the way as quickly as possible, run a short distance, and then allowed to coast. By this system a much larger proportion of the weight of a five or six-ton car train is available for brake purposes than where the same number of cars are pulled by a locomotive, there being an average of about 60 to 62 per cent. This makes it possible to run up to a total accelerating strain of at least 15,000 pounds per six-car train, and gives a rate of acceleration for the train exactly the same as in a single car—that is the train duplicates in all essentials in acceleration, speed and stopping rate, a single car. This system gives the railroad manager the utmost flexibility. He can operate at the shortest practical time intervals between trains, so as to get frequency of service, and yet he can increase the units to meet the requirements of the day to any amount. Cars can be run on branch lines coupled together, and others made up into trains of four, five and six cars on main lines, and afterward redistributed.

The automatic system of control lessens the maximum starting currents. It keeps the size of the motors well within the bounds of the size of trucks, which are generally limited both in width and wheel-base, and will have enormous value in increasing the traffic on the road, this being much more important than any saving of coal and attendance.

On elevated railroad structures the strains are very much reduced. Cars can be left out in siding or middle track and at any part of the road, and any number of cars can be run from either end of the battery without any head or tail switching.

On the night of July 25 a preliminary run was made, and on the 26th train units of one, two, three, four and six cars were operated at a speed as high as 33 miles an hour. The first time the car was sent down the track, the lever was started by Master Frank D'Esmonde Sprague, Mr. Sprague's nine-year-old son, who handled both the switch and the air-brake.

In the matter of the application of this system to the standard elevated railroad car, it may be said that it will entail no interference with the car at all, and the vestibule affects in no way the incoming and outgoing of passengers, while affording ample protection to the motorman.

The essential importance of the system is in enabling frequent time runs to be made instead of having intervals of from 45 seconods to 15 minutes, and train lengths of from three to five cars. The train units can vary from, say, one to six or more cars, all run at the same rates of acceleration and maximum speeds that can be attained with a single car, increasing, in a very material way, passenger schedule time with any fixed train schedule; because the passenger schedule is made up of two elements, waiting time at train stations and time of transit. As a rule, the traveler has only a limited distance to go, so that his own schedule may be very materially reduced from the train schedule by station wait.

The requirements of suburban service have not really been met heretofore, and the new system will go a long way not only to force the equipment of electric elevated trains, which are in direct opposition in the matter of frequency of service with trolley and cable systems, but also give an immense stimulus to suburban service.

The equipments for the test were gotten together in three weeks, the factories of the Sprague Company, the General Electric Company, of Schenectady and Lynn, the McGuire Manufacturing Company, of Chicago, and others being pushed to their utmost, and the work was rushed day and night. The first two cars were started July 16, and the number has been added to as the work progressed.

The leading features of the demonstration at Schenectady were the wonderful control and smoothness of operation of the system. The starting and stopping were equally prompt, and the train of six cars moved and was operated as if an individual car. The test was eminently successful, and it is understood that several large roads are very shortly to be equipped with the system. It is rumored that further important and radical innovations in railroad practice will soon be introduced in connection with the multiple unit system.

LETTERS TO THE EDITOR

THE LAKEWOOD, O., MUNICIPAL PLANT.

In your issue of July 22 we note an article relative to the alleged failure of the Lakewood, O., electric light plant. The article interests us this morning especially in view of the fact that the lights started last night, and to the greatest satisfaction of all concerned. We note that your article is based on quotations from a daily paper, and we should think that the statement that "the wires are rusting on the poles" would be sufficient to stamp the inaccuracy of the article. It is true that the contractor failed to complete his work, and that there was somewhat of a delay in straightening up the matter with the Security Company; nevertheless, the work has gone on, and there has not been the slightest hint as to mismanagement or corruption.

The superintendent suggested by us was engaged without reference to his politics, and, as a matter of fact, I do not even know what they are, nor the politics of any of the board of trustees. Although fully aware that many municipal plants are very badly managed, which is also the case with very many private plants, nevertheless, up to date the Lakewood plant has been entirely free from mismanagement and arrangements have been made which make it probable that such will be the case in the future. The water and coal will be measured, and we expect to criticise the operation and the bills. We appreciate your position against municipal management of electric light plants, but we also know that you do not desire to support your position by incorrect statements.

The article which you quote was only a matter of amusement to us until it was dignified by being referred to by you.

E. P. ROBERTS.

Cleveland, Ohio, July 24, 1897.

(We believe the facts were as we stated, but are glad to learn that the plant has at last got running.—EDS. E. E.

LEGAL NOTES

A TROLLEY INJUNCTION DISSOLVED.—THE U. S. CIRCUIT COURT OF APPEALS VACATES THE PRELIMINARY INJUNCTION AGAINST THE HOOSICK RAILWAY CO.

On July 21 the U. S. Circuit Court of Appeals reversed the decree of Judge Coxe and dissolved the preliminary injunction obtained by the Thomson-Houston Electric Company (General Electric Company) against the Hoosick Railway Company, for the use of the under-running trolley. By this action the Hoosick Company is permitted to continue the use of the trolley pending the trial of the suit.

We give below an abstract of the opinion of the court, written by Judge Wallace:

This is an appeal from an order granting a preliminary injunction restraining the defendant from making, using or vending the apparatus specified in claims 6, 7, 8, 12 and 16 of Letters Patent, No. 495,443, granted April 11, 1893, to the administrators of Charles J. Van Depoele, assignors to the complainant for "traveling contact for electric railways." The application for the injunction was resisted upon the ground that the patent as to these claims was void because the inventions covered thereby had been previously patented to the same inventor by Letters Patent, No. 424,695, granted April 1, 1890, for "suspended switch and traveling contact for electric railways." The validity of the claims, notwithstanding a similar defense, had been adjudicated at final hearing in the case of this complainant against the Winchester Avenue Railway Company by the Circuit Court for the District of Connecticut (71 Fed. Rep., 192). In granting the present injunction the court below followed that adjudication without attempting an independent consideration of the validity of the defense.

The question whether two patents are for the same invention is a question which is to be determined by a comparison of the documents themselves. Both patents originated in the application of Van Depoele, filed in the Patent Office, March 12, 1887. The application was divided, and while one of the

divisional applications was involved in an interference proceeding which delayed the issuance of a patent, the other divisional application culminated in the patent granted April 1, 1891.

The claims of the earlier patent are thirty-five in number, and are addressed more particularly to combinations between the conductor switches and the traveling contact; while the claims of the later patent, which are sixteen in number, are addressed more particularly to combinations between the traveling contact and the suspended conductor.

The five claims in controversy of the patent in suit are as follows:

"6. In an electric railway, the combination with a suitable track and a supply conductor suspended above the track, of a car provided with a swinging arm carrying a contact device in its outer extremity and means for imparting upward pressure to the outer portion of the arm and contact, to hold the latter in continuous working relation with the under side of the supply conductor, substantially as described."

"7. In an electric railway, the combination of a car, a conductor suspended above the line of travel of the car, a swinging arm supported on top of the car, a contact device carried by one extremity of the arm and held thereby in contact with the under side of the electric conductor, and a tension device at or near the other end of the swinging arm for maintaining said upward contact, substantially as described."

"8. In an electric railway, the combination of a car, a conductor suspended above the line of travel of the car, an arm pivotally supported on top of the car and provided at its outer end with a contact engaging the under side of the suspended conductor, and a tension spring at or near the inner end of the arm for maintaining said upward pressure contact, substantially as described."

"12. In an electric railway, the combination with a car, of a post extending upward therefrom and carrying a suitable bearing, an arm or lever carrying at its outer end a suitable contact roller and pivotally supported in said bearing, and provided at its inner end with a tension spring for pressing the outer end of the lever carrying the contact wheel upward, against a suitable suspended conductor, substantially as described."

"16. In an electric railway, the combination of a car, a conductor suspended above the line of travel of the car, an arm pivotally supported on top of the car and provided at its outer end with a grooved contact wheel engaging the under side of the suspended conductor, and a tension spring for maintaining an upward pressure contact with the conductor, substantially as described."

In considering the question whether both patents covered the same invention Judge Townsend in the Connecticut cause, speaking of the earlier patent, said: "The original application, filed March 12, 1887, claimed a spring and tension device so arranged as to impart upward pressure. The improved device showed a spring and weight so arranged as to permit lateral motion by the arm and to 'constantly tend to restore the arm to its normal central position and assist it to partake of the lateral movement of the car,' to give it a greater range of action and make it more convenient in operation. This patent for this specific combination adapted and claimed only for this specific purpose, applied for October 22, 1888, after the original application had been allowed but before the patent thereon had been granted, was earlier in the date of issue. The original application was delayed by interference proceedings in the Patent Office. Whatever may be the rule as to cases where the application for the general patent was filed subsequent to the application for the specific patent, I do not think the patentee should be deprived of his broad patent where the application for such patent was made first and was delayed in the Patent Office through no fault of the inventor."

With these conclusions we are unable to agree. We should concur if we could regard the later patent as the generic one, and the earlier, so far as it relates to the contact device, as limited to the structural improvements upon that device. But we are of the opinion that although the earlier patent contains matter of disclaimer inserted for the purpose of making the later patent ostensibly the generic one, so far as it relates to the contact device, such matter is antagonized by and is wholly inconsistent with some of the claims. Those claims in which the switching devices are not an element have no place in the patent, and would be in effect obliterated, unless they cover combinations between the suspended conductor and such a contact device as is described in the specification. In case of conflict, the claims, which are the final and definite expression of the patentee's intention, must control.

The operative parts of the contact device are described in identical language in each patent; and the language of the claims aptly describes these parts. While the function of the tension device is stated with more particularity in the earlier patent, the description does not contain a word or hint by which its characteristics can be differentiated from those of the tension device of the later patent. The additional matter is in effect a fuller statement of the advantages of the device.

As described in each specification the tension device is a spring which is held in its proper place by the weight. The spring alone, if fastened to the top of the car, would perform the function of restoring the arm to its normal central position; so would the weight "secured by a cord which passes downward through suitable grooves" (or through the roof of the car as shown in the drawings). The weight and spring together re-enforce one another and allow greater freedom of movement to the arm when arranged as described and shown in both patents. The device of necessity exerts a centralizing tendency upon the arm, and serves to maintain upward contact between the grooved wheel and the suspended conductor. Of course, if the claims of the earlier patent do not specify such a tension device as is described and claimed in the later, but specify one which embodies only a subordinate improvement upon it, the patents are not for the same invention. As was said by this court in Thomson-Houston Electric Company v. Elmira Company (71 Fed. Rep., 404): "An inventor, by describing an invention in a patent granted to him, does not necessarily preclude himself from patenting it subsequently. His omission to claim what he describes may operate as a disclaimer or an abandonment of the matter not claimed; but it has no such effect when it appears that the matter thus described but not claimed was the subject of a pending application in the Patent Office by him for another patent. The invention secured by a patent is that which is secured to the patentee by the claim. The claim, however, is to be read in the light of the description contained in the specification, and its literal terms may be enlarged or narrowed accordingly, but not to an extent inconsistent with their meaning. Identity of language in the claims of two patents does not necessarily import that the invention patented by each is identical, nor does a difference in the phraseology necessarily import that they are for different inventions. The test of identity is whether both, when properly construed in the light of the description, define essentially the same thing. When the claims of both cover and control essentially the same subject matter both are for the same invention and the later patent is void."

Inasmuch as the only tension device, or means for imparting upward pressure to a trolley arm described in the specification of the later patent is that which consists of a weight and spring as it is described in the earlier patent, the verbal differences in defining its functions in the several claims (of the two patents) are of no significance. The thing itself is the same in the claims of both patents.

If any importance is to be attached to these verbal differences, the earlier patent claims a tension device the chief function of which is to exert a normal centralizing tendency upon the arm, but which of necessity must maintain the upward pressure, while the later patent claims one of the chief functions of which is to maintain upward pressure, but must of necessity also exert the normal centralizing tendency. If there had been in the description anything by which could be ascertained which of the structural features exercises one function and which the other a different case would be presented. "The matter sought to be covered by the second patent is inseparably involved in the matter embraced in the former patent, and this, under the authorities, renders the second patent void." Miller vs. Mfg. Co. (151 U. S., 198).

Claim 13 of the patent in suit for the combination between the suspended conductor, the contact device, and the switching devices is identical in its phraseology with claim 6 of the earlier patent.

The later patent describes the switching devices of the earlier patent in all their essential features, except as to the subordinate improvements thereon and claim 13 must be construed as specifying the identical invention specified in claim 6 of the earlier patent. On the other hand, claim 15 of the earlier patent for the combination between the suspended conductor and the contact device is identical in phraseology with claim 9 of the patent in suit.

We are of the opinion that claim 15 of the earlier patent describes and embraces everything of substance which is covered by claim 7 of the patent in suit. Claim 15 specifies a combination, the elements of which are the car (implied necessarily, and needlessly mentioned), the suspended conductor and the contact device. The element termed "a contact carrying arm pivotally supported on the top of the car and provided at its outer end with a contact roller engaging the under side of the suspended conductor" exactly defines all the essential features of the contact device described in each specification, except the tension device. It must be hinged as well as pivoted, otherwise the tension device will be inopera-

tive to maintain upward pressure. The element termed "a weighted spring," is the complete tension device described in both specifications and which as described necessarily exercises the two-fold function of maintaining upward contact between the contact device and the suspended conductor and of maintaining the pivoted arm in its central or normal position. The "tension device" of claim 7 is the whole device described in that patent as the "weighted spring" of claim 15, is the whole device described in the earlier patent.

Claim 15, however, does not specify the combinations of claims 8, 12 and 16 of the patent in suit. The "tension spring" of those claims is not necessarily the "weighted spring" of claim 15.

We are also of the opinion that claim 33 of the earlier patent specifies essentially the same combinations embraced in claims 8, 12, and 16 of the patent in suit, and that the "spring or weight" of claim 33 is the same thing as the "tension spring" of claims 8, 12 and 16, the "weight"being only an alternative element. It would be a waste of time to dwell upon the verbal differences in these claims. The changes in phraseology import nothing of substance into their respective combinations. They describe the same things in different language and the draughtsman seems to have expended great ingenuity in cataloguing a group of synonyms.

The order granting the preliminary injunction is reversed with costs.

UNDERRUNNING TROLLEY AND SUSPENDED SWITCH.—THE DETROIT CITIZENS STREET RAILWAY CO. ENJOINED.

On July 15 Judge Swan, of the Sixth U. S. Circuit Court, at Detroit, granted a preliminary injunction restraining the Detroit Citizens Street Railway Company, of Detroit, from the use of the under-running trolley as covered by claims 2, 4, 6, 7, 8, 12 and 16 of the Van Depoele patent, No. 495,443, of April 11, 1893.

On the same day Judge Swan also granted a preliminary injunction against the same road prohibiting it from using the suspended switch as covered by the Van Depoele patent, No. 424,695, of April 1, 1890.

In both instances the Detroit road was given sixty days in which to substitute non-infringing apparatus.

A DECISION IN FAVOR OF THE CARBORUNDUM CO.

On July 27, Judge Buffington handed down a decision in favor of the Carborundum Company, in the case of Cowles vs. the Carborundum Company.

TROLLEY CURRENT INTERFERENCE WITH TELEGRAPH CIRCUITS.

The Postal Telegraph Company's allegation that its wires in Falmouth, Me., are being rendered nearly useless by the close proximity of tne trolley line of the Portland & Yarmouth electric railway, now in progress of construction, is the basis of the suit for a temporary injunction, which will come up for a hearing in the United States Court, July 31.

The electric railway company's reply to this allegation is to the effect that the Portland & Yarmouth Electric Railway Company has absolute right, under its charter, for the location of its wires and poles, and that the location has the indorsement of the municipal officers of Falmouth; that the Postal Telegraph Company never obtained any legal right to set poles within the town of Falmouth; that in the construction of its road the electric railway company has used all possible care to avoid injury to or interference with the poles or wires of the telegraph company, and any injury or annoyance that may have happened has been due solely to the neglect of the telegraph company to change the location of its poles, which it has had ample time to do since receiving notice to that effect.

CARBIDE OF IRON IN THE ELECTRIC FURNACE.

The results of some recent researches on the direct union of carbon and iron at a high temperature have been communicated by the author, M. Moissan, to the French Academy of Sciences. He states that when pure iron and carbon are melted together in an electric furnace and allowed to cool slowly, the metal is found to contain only a very small quantity of combined carbon, a gray pig iron being obtained that solidifies at 1,150 degr. Cent. By suddenly cooling in water iron saturated with carbon at 3,000 degr., the metal became crystalline in structure, and from it were separated brilliant crystals of carbide of iron.

TRADE NOTES & NOVELTIES

THE MASON TERRA COTTA CONDUITS.

GRADUALLY but surely electric light and railway companies are recognizing that not only safety but economy of operation is secured by placing their circuits underground.

The Potomac Terra Cotta Company, whose office is at No. 36 Corcoran Building, Washington, D. C., were the pioneers in the manufacture of terra cotta conduits for underground electric wires, having introduced them as early as

FIG. 1.—MASON ELECTRICAL SUBWAY CONDUIT.

1887. These conduits were made in several forms, principally rectangular, with two, four and six ducts, and were patented by Hon. John Lynch and Wilmot Lake, and generally known as the Lynch-Lake system. They were introduced and extensively used in Washington, Baltimore, Cleveland, Buffalo, Milwaukee, St. Paul, Chicago and elsewhere.

To obviate objections to the rectangular duct, Mr. George Mason, president of the Potomac Terra Cotta Company, devised what is now known as the "Mason" duct, which was first laid in October, 1896, in Washington, D. C., by the Postal Telegraph-Cable Company, and since then by the Chesapeake and Potomac Telephone Company, giving great satisfaction

FIG. 2.—MASON ELECTRICAL SUBWAY CONDUIT.

where used and eliciting universal commendation from experts in this line of work.

The accompanying engravings illustrate the Mason conduit, which is made in two and four-way ducts, the sections being connected by dowels of wood or other material and the center opening serving to carry a return wire.

Testimonial letters in the possession of the Potomac Terra Cotta Co. from the two companies above mentioned leave no doubt as to what conduit they will employ for extensions.

C & C APPARATUS IN THE WEST.

Sargent & Lundy, per Mr. M. J. Insull, Monadnock Building, Chicago, have issued the following notice to the trade: We take pleasure in informing you that we have associated ourselves with the C. & C. Electric Company, of New York, in the capacity of General Western Sales Agents, with our office at No. 13 to 15 Monadnock Building. We shall carry at this office a complete line of C. & C. apparatus from which shipments can be made promptly. In soliciting your business we would respectfully remind you that the C. & C. apparatus has been on the market for the past ten years; the universal success that it has met with is a guarantee of its satisfactory operation. The C. & C. Company, in addition to their well known types of bipolar machines, are now manufacturing a full line of multipolar generators for direct connection, or belted, and also a line of multipolar motors of the ironclad type. Kindly address all future inquiries to us at No. 13 to 15 Monadnock Building, Chicago, where they will receive immediate and careful attention.

EXTENDING USE OF CHLORIDE ACCUMULATORS.

It is a significent fact that the largest users of storage batteries are those who have given the subject of their manufacture and application the greatest amount of study. Four of the Edison Companies equipped with chloride accumulators have contracted for duplicate plants, i. e., New York, Brooklyn, Boston (3 installations) and Lawrence, Mass. About a year ago a battery of chloride accumulators was installed in the New York Custom House for the purpose of furnishing current for 12 hours per day when the dynamos were shut down. A contract has just been closed by the Electric Storage Battery Company for a second plant to be installed in the New York Custom House, to be used for maintaining the night lamps in the Sub-Treasury and the Assay Office.

Other contracts recently closed cover batteries of chloride accumulators for the San Francisco Gas & Electric Company, the Criminal Court Building, the Commercial Cable Building, the Queens Insurance Building, N. Y.; the State Mutual Assurance Company's new building, at Worcester, Mass.; and Messrs. Smith & Wesson, Springfield, Mass.

The installation of two batteries of large capacities has just been completed for the Consolidated Traction Company of Pittsburg, where they are used for regulation and maintaining the potential on their trolley lines, and the Barre & Montpelier, Vt., Railway Company has just contracted for a battery for regulation. The Postal Telegraph and Cable Company are installing chloride accumulators in their offices at Albuquerque, New Mexico, and El Paso, Texas.

Among the yachts which have been equipped with chloride accumulators this year, are: Embla, Alicia, Sapphire, Clermont, Pioneer, New Hiawatha, Marretta, Punjaub, Raynham, Althea, Satanella, etc.

THE VULCAN FOUNDRY CO., PROVIDENCE.

An event of unusual importance in the mechanical and engineering field at Providence, R. I., is the organization of the Vulcan Foundry Company, whose works are to be established at once at Pawtucket, in the vicinity known as Darlington. The company has a capital of $100,000, which was oversubscribed, and the directors are such well known men as Darius L. Goff, Gardiner C. Sims, and W. P. Dempsey. The officers are, Mr. Goff as president, and Mr. Sims as treasurer, and the numerous friends of the latter gentleman, in the electrical field, will hail gladly this evidence of his return to active business life. It is the intention to have one of the largest and most complete establishments of the kind in New England, and the foundry will start with a considerable custom already secured.

TRIUMPH ELECTRIC APPARATUS AT THE TENNESSEE CENTENNIAL.

A good deal of important work is now being done at the Tennessee Centennial by apparatus of the Triumph Electric Company, of Cincinnati, installed by Mr. John W. Chester, manager of the company's Nashville office.

Thus there has been furnished a 75 k. w., 500-volt generator in connection with a 14 x 14 Imperial engine, built by the Weston Engine Company, of Painted Post, N. Y. This plant furnishes power to all the motors in the different buildings on the grounds, and also power to operate the Giant See-Saw, the machinery for which was designed by Mr. Chester.

In addition to the above the company have a 15 k. w. multipolar, 110-volt generator as a special exhibit, driven by a Lane & Bodley engine, and a display of arc and incandescent lamps operated by the machine.

WALKER CO. IN CHICAGO.

Mr. George B. Foster, formerly of the electrical department of the World's Fair, has associated himself with J. Holt Gates & Co., 1323 and 1324 Marquette Building, Chicago, in the sale of Walker Company, Card Electric Company and Wagner Electric Manufacturing Company apparatus. Mr. Foster's varied experience in the electrical field renders him a very valuable man.

Mr. George W. Henry, formerly Western manager of the Steel Motor Company, has also associated himself with J. Holt Gates & Co. Mr. Henry is one of the pioneers in the electrical business, and has been very successful in the exploiting of electrical goods in the West.

Mr. F. B. Duncan, formerly foreman for Siemens & Halske Electric Company and later of the Northern Electric Company, of Madison, has likewise become associated with the Gates Company. His technical experience should bespeak for him a creditable career as a salesman.

A NEW WESTERN ELECTRIC SWITCH CATALOGUE.

The Western Electric Company, of Chicago, has just issued a very beautiful and complete catalogue of its E, EE and Q switches. The different-sized switches are described by numbers with their capacity in amperes, and all the dimensions of the switches are plainly given in tables, so that it is possible to drill switchboards before the switches are received, with the assurance that the switches will fit when they are placed in position. Further than this, a cut and catalogue number of every switch part is given, which facilitates the ordering of small parts at any future time. Special switches are made for 500 volts, and the Q switches, which represent the quick break type, are made in all sizes from 25 amperes up. There is also shown in the catalogue the latest design of the round type Ellicott voltmeter switch, the "V" changing switch and the switchboard spring jacks, plugs and cords, all of which are extremely high grade. A copy of this catalogue will be sent upon application.

IMPROVED ROENTGEN RAY APPARATUS.

In designing their new line of X-ray coils, Messrs. Queen & Co. have given careful attention to proportioning the different parts so as to get a very heavy and continuous secondary discharge with the smallest possible amount of wire. The distribution of the wire on the secondary was determined by measuring the discharge from single coils of a few turns of wire which were placed at intervals throughout the field of the primary. From the data obtained by these tests curves were plotted showing the proper distribution of wire for coils of all sizes. Similar methods were used to determine the size and number of turns of the primary and the amount of iron in the core.

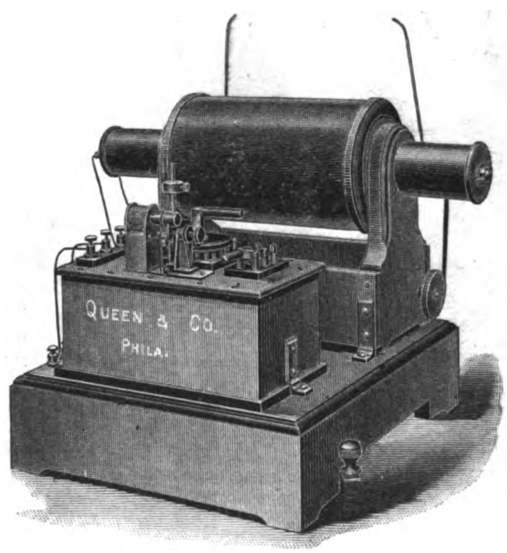


FIG. 1.—QUEEN & CO.'S IMPROVED X-RAY APPARATUS.

In the choice of insulating materials, and in assembling, the greatest possible care is used. Methods are employed which remove absolutely all air from the insulating material of the secondary. The spark points are adjusted by the hard rubber disc shown at the left of the base, which is so well insulated that the operator is in no danger of receiving a shock, even when the points are opened out to the full extent.

Two of the binding posts shown at the left in the illustration, are connected to the batteries, or lighting circuit, and the other two to the induction coil. The vibrator is operated by means of a small coil, shown in the cut, which is a shunt from the main circuit. An independent set of contacts makes and breaks the circuit through this coil; these are in front of the main contacts, and a switch near the binding post opens and closes the shunt circuit. The main circuit is controlled by the reversing switch shown at the right.

The movable platinum contact is carried on a small vertical spring behind the vibrator spring. When the contact is made the movement of the vibrator is not arrested, but continues to its full amplitude, thus allowing a long "make." The length of the "make" can be varied by screwing in or out the other platinum contact. The most important advantage of this arrangement is the suddenness of the "break," which is accomplished by the collar in the vibrator spring striking the movable contact while at full speed. In the new form as the break is made when the vibrator is at the middle of its swing,

the sudden blow with the entire momentum of the vibrator head is always sufficient to break the platinums apart, and once started the vibrator continues in motion until the current is turned off. The suddenness of the break makes it possible to use this form of vibrator on the 110-volt as well as battery circuits, it also adds very greatly to the efficiency of the induction coil with which it is used.

A rod screwed into the iron head carries a weight which may be moved up and down and clamped in any position with a setscrew. By this means the rate of vibration may be varied within wide limits.

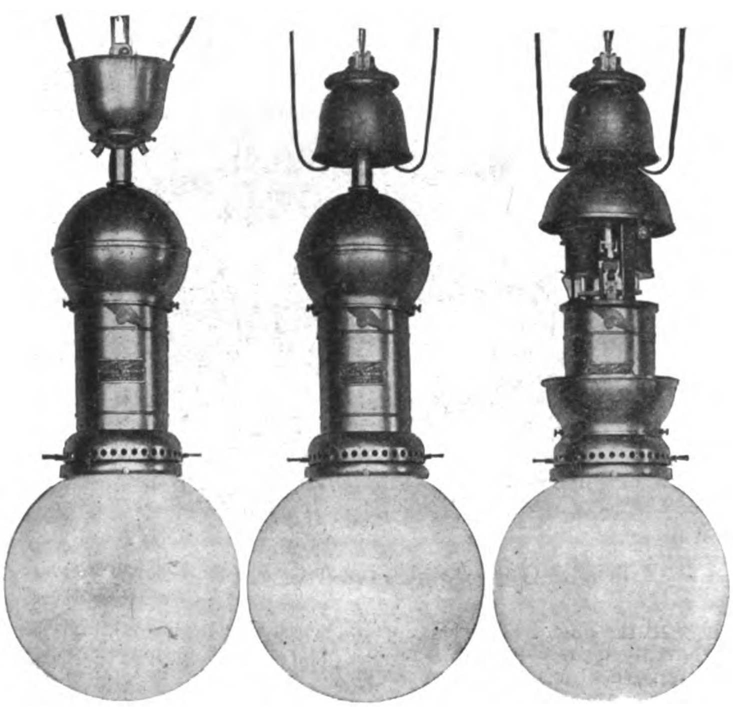
The outfits complete for X-ray work consist of a coil mounted on a base, with rheostat if used for 110-volt circuit, and with an adjustable condenser and independent vibrator mounted on the same base, as shown. In addition to this a number of tubes, suitable stand, fluoroscopes, etc., are included with each set.

NEW WESTERN ELECTRIC CO. 150-HOUR ENCLOSED ARC LAMP.

THE general design of the new 150-hour enclosed arc lamp of the Western Electric Company, is a marked departure from previous practice in this line.

By a special arrangement the rheostat and canopy containing the rheostat are adapted for either outdoor or indoor use, as shown in the illustration, slight change only in the arrangement of these parts being necessary to fit it for either use. This change can be made in a few minutes.

In the distribution of light great attention has been paid to all features giving a uniform distribution with freedom from shadows; also to giving the maximum illumination under such circumstances.



FIGS. 1, 2 AND 3.—NEW WESTERN ELECTRIC CO. 150-HOUR ENCLOSED ARC LAMP.

The large spherical globe is suspended entirely from the top and is without a lower opening; this, together with the arrangement of the inner globe and its means of support, form an ideal combination which is highly efficient in the matter of distributing the light from the arc over the area where it is most needed, and at the same time securing a uniform and pleasing illumination of the entire globe.

The regulating mechanism while of the simplest construction and requiring a minimum of energy to operate, is very effective and controls the voltage and current of the arc with such nicety that great steadiness and constancy in the light result. The lamps are equipped with either series or shunt controlled regulating mechanism as desired, so that they can be operated either singly on a constant potential of 110 volts, or a number in series upon higher potentials. Where a number are used in series an automatic cut-out is supplied, which, upon the consumption of the carbon in any one lamp of the series, will operate to extinguish the lamps and prevent injury.

For trimming, the globe is readily lowered, being held in the lower position by projecting arms attached to the side arm of the lamp, after which the inner globe, together with its lower carbon holder, can be removed for trimming, or be replaced by a fresh inner globe and lower holder already trimmed, the upper carbon having first been put in place.

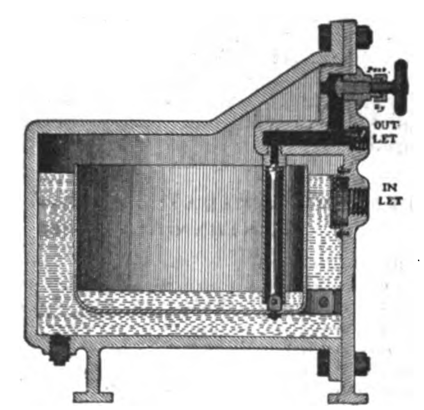
The carbons used are solid, ½ inch in diameter, 12 inches for the upper and 5 inches for the lower. After the lamp has burned 150 hours, there is still enough of the upper carbon left to be used for a lower in retrimming.

All lamps are equipped with spring-actuated switches, making a large, quick break which precludes the possibility of the formation of a persistent arc at the switch. These switches are also adapted to be operated by a simple pushing movement which may be communicated by a pole, by which they can be reached from the floor.

The lamps are finished in black, oxidized copper or any style the purchaser desires. The stem upon which the lamp is supported may be made any length to suit the height of the ceiling. In the accompanying engravings Figs. 1 and 2 show the lamp as arranged for indoor and outdoor use, respectively, and Fig. 3 shows it with the shell lowered, exposing the mechanism.

KIELEY & MUELLER'S STANDARD STEAM TRAP.

OF their many specialties in steam heating and regulating supplies no record is more satisfactory to Kieley & Mueller, 7 West Thirteenth street, New York, than that of their standard steam trap for automatically draining the condensation from all kinds of steam apparatus, independent of returning it to the boiler. While it is made to work under an incipient pressure of 100 pounds, it is used in the U. S. Navy ships at 250 pounas, and is in wide request for the high pressure plants of electric light stations, for the work of which it is peculiarly fitted. Wherever it is employed there is no further trouble with the water of condensation. The float, being an open one, prevents all danger of collapse; and, as it is hinged to the cover, its power is increased to three or four times that of many open floats used in drain traps. All the working parts are fastened to the cover, to which are also connected the inlet and outlet pipes. The result is that by simply unbolting the body of the trap and moving it back,



KIELEY STANDARD STEAM TRAP.

all the working parts can be seen in the position of action. As the inlet and outlet pipes are connected to the cover only, the trap can be taken apart and cleaned without disconnecting a single pipe. The pass-by, when open, allows the air and water to pass out of or through the trap independent of the opening controlled by the float. This arrangement, besides other advantages, obviates the otherwise necessary cost of a valve, pipe, fittings and labor in making a pass-by.

FIRE IN THE EXCELSIOR ELECTRIC CO.S FACTORY.

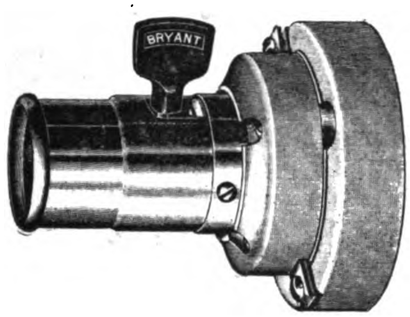
On July 27 a fire that was subdued in half an hour caused damage estimated at $15,000 in the Excelsior Electric Company's four-storied building fronting on Willoughby street, between Navy and Raymond streets, Brooklyn. The flames were confined to the top floor in the lamp department. The damage was mostly due to water, the machinery remaining untouched, so that the factory will be in running order within a few days. The factory, etc., is fully insured.

THE AMERICAN ELECTRICAL WORKS CLAMBAKE at Providence, R. I., is to take place on August 21, at the Pomham Club. Invitations are just out.

THE BRYANT FUSIBLE WALL SOCKET.

THE accompanying engraving represents the Bryant fusible wall socket, which the Bryant Electric Company, of Bridgeport, Conn., are now placing upon the market.

This device consists of the standard Bryant socket mounted on a "K.W." rosette, making a combination which will be found very useful as it is fusible and can be furnished in either the key or keyless Westinghouse or Thomson-Houston base. The



BRYANT FUSIBLE WALL SOCKET.

shell of the socket is held in place on the base by three bayonet joints, which makes it thoroughly rigid and solid, capable of supporting any weight of shade or lamp without sagging. The socket, being fitted to the rosette cap, can be used with any of the regular rosette bases, all caps being interchangeable.

BRISTOL'S NEW ATMOSPHERIC RANGE RECORDING THERMOMETER FOR CLOSED SPACES.

THE instrument here illustrated has been developed to meet a demand for a recording thermometer for atmospheric ranges of temperature that can be applied to air, gases or liquids in a closed pipe or room. Fig. 1 shows the complete instrument which consists of a Bristol recording pressure gauge, in which the helical tube is completely filled with expansible

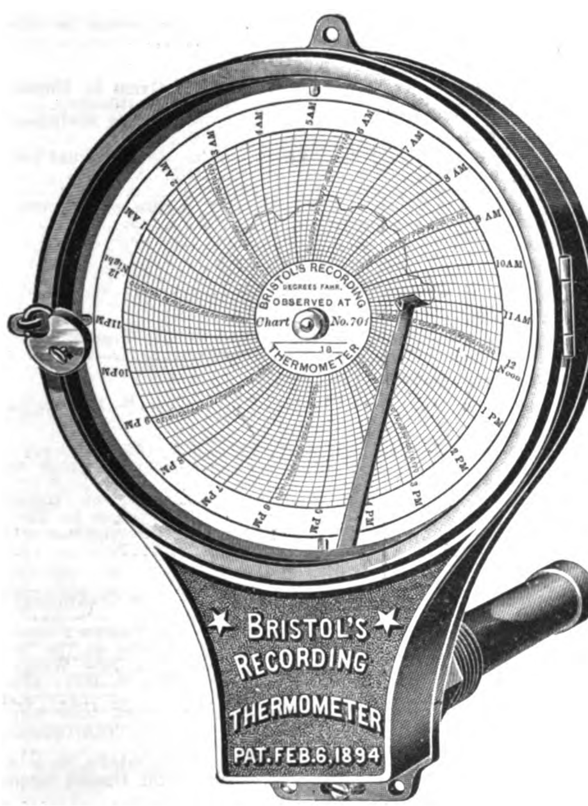


FIG. 1—BRISTOL RECORDING THERMOMETER.

liquid. This tube, which is sensitive to and is operated by changes of temperature, is inclosed in the cylinder projecting from the back of the case of the recorder, as shown in Fig. 1. This cylinder protecting the sensitive tube is furnished with a screw thread so that it may be conveniently located within a gas main, through the side of a tank, or through a partition of a room, as may be desired. Fig. 2 is an illustrative outline of one of the thermometers as applied to a large gas main; A, representing the protected sensitive tube; B, a cross-section of gas main, and C, the recording portion of the instrument.

It will be observed that the operative part of the thermometer is entirely protected from any action of the gases or liquids of the temperature which is being recorded, hence the

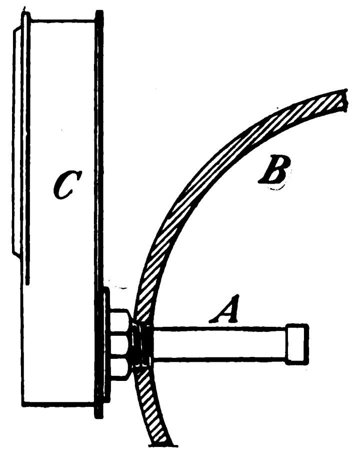


FIG. 2.

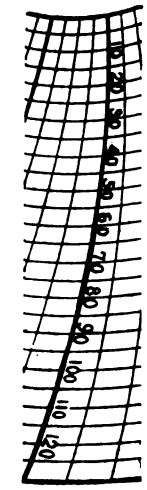


FIG. 3.

operation of the instrument is absolutely independent of the pressure or vacuum within the closed space.

Fig. 3 shows a specimen section of the chart of these thermometers for a range from 0 to 130 degs. F. Other ranges may be made by using weaker or stronger pressure gauge tubes. By varying the quantity of expansible liquid inclosed in the pressure tube, the lower end of the scale may be limited, and a very open scale provided at the normal degree of temperature. These instruments have been in successful operation for several months. They are being made and placed on the market by the Bristol Company, of Waterbury, Conn.

ADVERTISERS' HINTS

THE ELECTRIC SUPPLY CO., Madison, Wis., state that the month of June beats the record and that their goods and prices are all right.

THE PEOPLE'S ELECTRIC COMPANY, Madison, Wis., announce that they always have a full line of electrical supplies on hand.

THE WESTERN ELECTRIC COMPANY, Chicago and New York, illustrate and describe some types of their new 150-hour enclosed arc lamp. A description may also be found on a preceding page of this issue.

A. R. SPICER, Hoytville, Pa., advertises chestnut poles for trolley, electric light or telephone line construction. A card to Mr. Spicer will elicit full information.

THE WESTINGHOUSE MACHINE COMPANY, Pittsburg, Pa., recommend the Westinghouse engine as a representative American product for which there is a steadily increasing demand in the markets of the world, and state that this recognition is solely on the basis of merit.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, Ill., call attention to their stock of electrical supplies as carefully selected and made up of only the best material.

THE ORIENT ELECTRICAL COMPANY, Youngstown, O., advertise incandescent lamps at 17 cents in barrel lots.

THE GENERAL ELECTRIC COMPANY advertise electric lighting generators, direct connected or belted, for the smallest isolated plant or the largest central station.

THE BRYANT ELECTRIC COMPANY, Bridgeport and Chicago, advertise fusible wall sockets.

THE AMERICAN MANUFACTURING COMPANY, 46 So. Water street, Cleveland, Ohio, are in the market with the Globe water motor fan and are prepared to make prompt shipments.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., call attention to their step-up and step-down transformers for long distance power transmission sys-

tems. They illustrate a group of six 600 k. w. 10,000 volts water-jacketed transformers as installed at Riverside, Cal., where they have proved high grade in every respect.

NEW YORK NOTES.

THE ELECTRIC ARC LIGHT COMPANY report a largely increasing business. They are receiving large orders with every mail for "Pioneer" long-hour enclosed arc lamps and have been compelled to add to their already large force in order to meet the demands. One of the largest of the numerous contracts that have been taken by this company is that of Messrs. Abraham & Strauss, retail dry goods merchants, of Brooklyn, N. Y., who are equipping their new establishment with "Pioneer" lamps. This building is an addition to their already large quarters, and, as soon as this installation is completed, the entire establishment will be equipped with "Pioneer" lamps. This is one of the largest contracts ever given for arc lamps.

THE NON-POLARIZING DRY BATTERY COMPANY, 347 West Broadway, New York, are booking good orders throughout the country for their O. K. dry battery, of which they are the manufacturers. The battery is showing exceptional results wherever it is used, which accounts for the large demand that is keeping the factory busy filling orders.

J. B. COLT & CO., 115-117 Nassau street, New York, are issuing a highly interesting catalogue in conjunction with their stereopticons, magic lanterns, etc., which they will be pleased to mail to any address upon application. It covers many other things besides lanterns, all of great interest and use for business and recreation.

CHARLES ARTHUR HAGUE, 39 Cortlandt street, New York, for a number of years has been the consulting and designing engineer for many plants throughout the country. His specialties are power plants for electric light and power stations; steam and electric pumping machinery; also special steel pipes for high pressures. Mr. Hague installs complete plants, guaranteeing them. Correspondence on the subject is solicited by him.

THEO. AUDEL & CO., book publishers, 63 Fifth avenue, New York City, are distributing a new and very neat catalogue of their books relating to the steam end of electricity. The catalogue, which is illustrated and printed in three colors, will gladly be sent to any address upon application.

EDISON MFG. CO., 110 East Twenty-third street New York, report a very satisfactory business in fan motors. The demand for these goods as well as other specialties of their make is keeping them unusually busy for this time of the year.

MR. C. H. FLORANDIN, of the C & C Electric Company, has safely returned from an extended trip abroad.

NEW ENGLAND NOTES

BOSTON MOTOR COMPANY, 17 Batterymarch street, Boston, have issued a neat catalogue of their experimental electrical supplies, showing their apparatus of all kinds, including batteries, motors, fans, X-ray outfits, telegraph keys, telephones, etc. The neat pamphlet is supplemented by electrical tables and formulæ.

A. & J. M. ANDERSON MANUFACTURING COMPANY, 289—293 A street, Boston, are making a good deal of a specialty of heavy switchboard work, and are issuing an illustrated price-list which embodies some of their admirable work in this direction. They have had a long and ripe experience in this field. They make their own copper castings, and all the details are carried out with the utmost care and precision. They are now placing on the market also the Hancock quick break switches, which have not been listed before, but are already very largely used. They will be glad to receive inquiries or send copies of the price list.

SHAWMUT FUSE WIRE COMPANY, 93 Federal street, Boston, Mass., have just issued a very neat, descriptive catalogue and price list of their tested fuse wire, tested fuse links, copper knife switches, etc. They will be pleased to mail catalogue to any address upon application.

THE O. C. WHITE COMPANY, Worcester, Mass., will soon put on the market several new specialties in brackets, etc. Their shop is running full time.

WESTERN NOTES

BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, are issuing a series of admirable bulletins, quarto size, profusely illustrated with fine cuts, devoted to their various classes of high class apparatus, in the line of generators and motors. One bulletin, for example, describes and illustrates the larger sizes intended for generators. Another is concerned with direct connected, slow speed motors for all makes of printing presses, and various types are shown and details are gone into. Another of the bulletins shows slow speed, direct connected motors for machine tools and other machinery. These pamphlets afford a striking idea of the immense strides now being made by motors in the conquest of the printing and factory fields.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXIV. AUGUST 5, 1897. No. 483.

THE 150,000 H. P. ST. LAWRENCE POWER DEVELOPMENT, NEAR MASSENA, N. Y.

INTRODUCTORY.

As already announced and briefly outlined in our columns an electric water-power development is to be carried out near Massena, N. Y., which exceeds in magnitude anything of the kind ever attempted, not excepting even the stupendous undertaking at Niagara. The entire working capital for carrying out the enterprise has been subscribed and contracts for all the work have been let, including fifteen electric generators of 5,000 h. p. each, with a like number of turbines of similar capacity.

THE PHYSICAL CONDITIONS.

Unique physical conditions have made possible the great development of power at Massena, with comparatively moderate outlay. The elements necessary for use of water-power are water in ample volume and fall practically available. With very great height of fall a moderate volume of water will produce the same amount of power, as much greater volume with much less height of fall. The volume must be constant to the extent required in order to secure continuous power. Many streams which have considerable falls have so great variations in the volume of flow as to render only very moderate developments of power practicable throughout the whole year. At Massena the volume of the St. Lawrence River is so great as to render certain constant continuous power to an extent far beyond anything that has ever been attempted.

The physical conditions are the St. Lawrence River carrying the enormous volume of water gathered from all the great American lakes, and having at Long Sault rapids a fall of over 50 feet; southerly from the southern shore of the St. Lawrence above these rapids there extends a comparatively level plateau of about three miles where it meets the valley of the Grass River, the water in which at this point is about 45 feet below that of the St. Lawrence above the rapids. (See map, Fig. 1. The Grass River has but a small volume of flow and enters the St. Lawrence below the rapids. A canal carrying the waters of the St. Lawrence from a point above the rapids to the valley of the Grass River will deliver that water upon turbine wheels with an absolute head of over 40 feet. This water, after actuating the turbines, will flow through the valley of the Grass River, and re-enter the St. Lawrence below the rapids. The head race of this power will thus be the St. Lawrence River and three miles of canal; the tail race will be the Grass River itself.

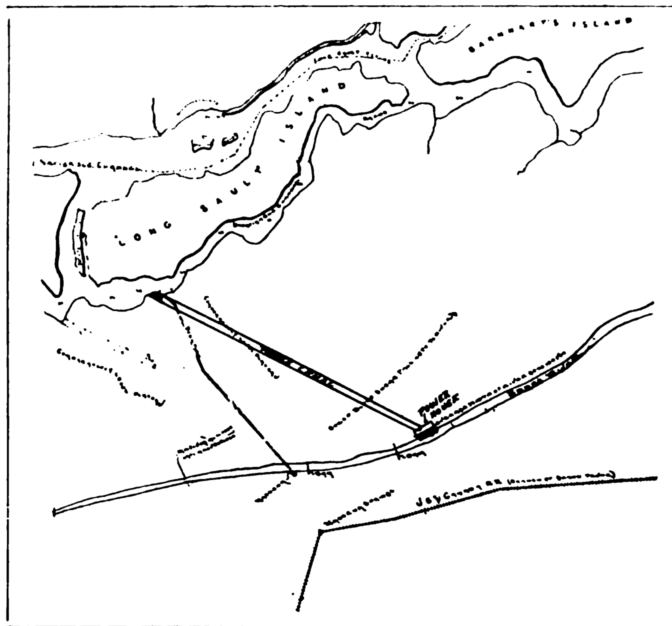
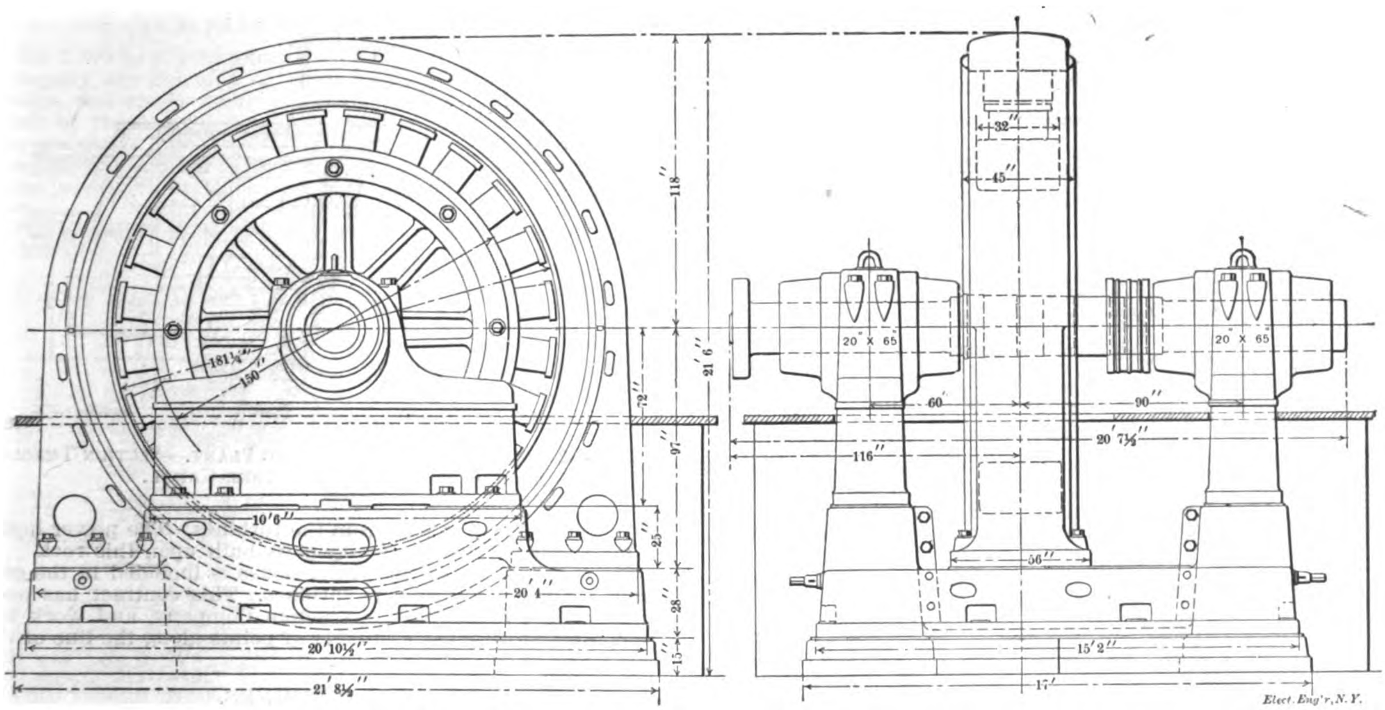


FIG. 1.—MAP OF MASSENA, N. Y., SHOWING LOCATION OF POWER HOUSE AND CANAL.



FIGS. 6 AND 7.—5,000 H. P. WESTINGHOUSE THREE-PHASE GENERATORS, ELECTRIC GENERATING PLANT, MASSENA, N. Y.

THE POWER CANAL.

After careful consideration of the commercial requirements that can be depended upon to utilize power at this point, the St. Lawrence Power Company has determined to construct a

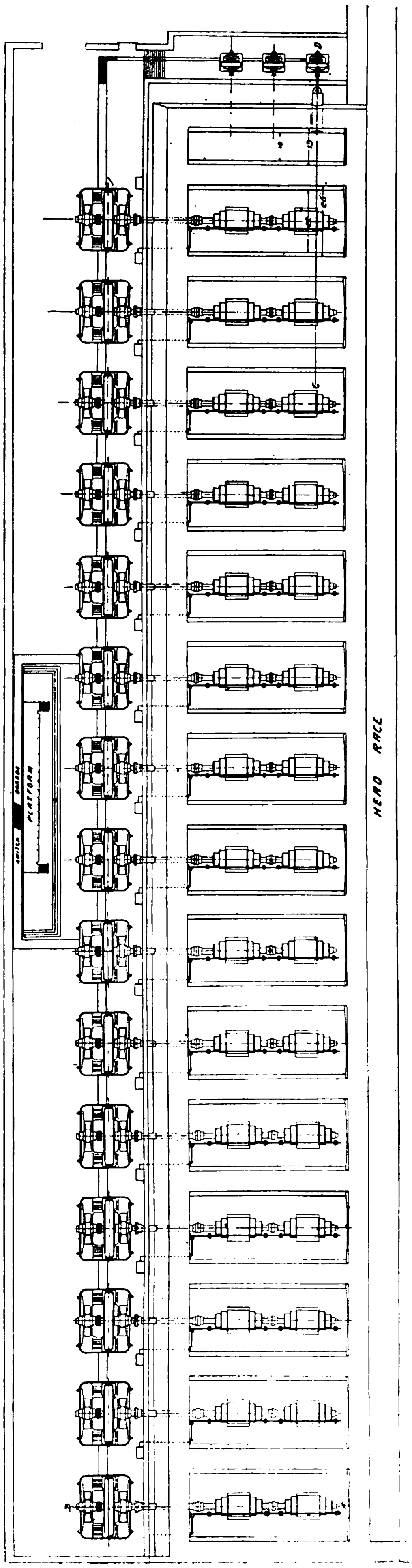


FIG. 2.—MASSENA ELECTRIC GENERATING PLANT.—PLAN OF POWER HOUSE, SHOWING ARRANGEMENT OF DYNAMOS AND TURBINES.

canal across this plateau of such size as to carry sufficient water to the valley of the Grass River to develop 150,000 h. p., and to at once build at the Grass River a power house and to furnish it with turbines and electric generators sufficient to develop, before the close of the year 1898, electric current to the extent of 75,000 h. p. There will be thus available for future use sufficient water to double this immediate output,

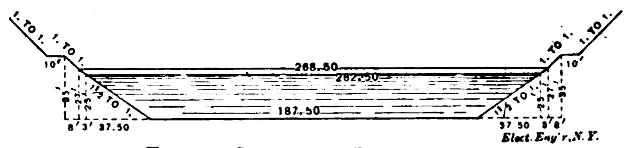


FIG. 4.—SECTION OF POWER CANAL.

and this can be used either for direct power in mills or other manufactures, or can be transformed into electricity.

The size of the canal for which contracts have been made and work upon which is now in progress, will be 225 feet wide and 25 feet deep; the sides will have slopes adapted to the material through which the canal passes. The line of the canal is nearly straight from the one river to the other. It is entirely in cutting, thus avoiding the dangers incident to embankments. The volume of material to be excavated is large, but as the excavation is entirely in earth the expense will be very moderate, as compared with its great volume. The Grass River flows upon a limestone formation, but the plateau between it and the St. Lawrence River is entirely alluvial, the material being sand, clay and gravel. The head of the canal at the St. Lawrence River is immediately below a slight promontory, which deflects to the opposite shore the ice and drift coming down from the upper river and lakes. The banks of the Grass River, where the canal approaches them, are over 40 feet in height.

THE POWER HOUSE.

The power house will be founded immediately upon the rock bed of the Grass River, and will receive the water for power from the canal which terminates in the elevated bank behind the power house. This power house will be between 500 and 600 feet long and 130 feet wide. The rock in the bed of the Grass River will be excavated so as to afford ample area for

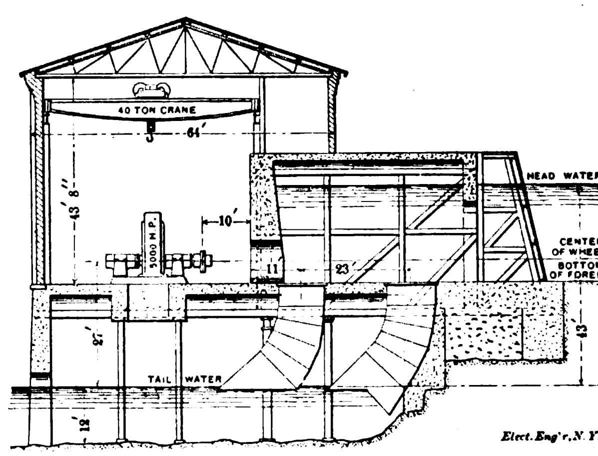


FIG. 3.—MASSENA ELECTRIC GENERATING PLANT.—SECTION THROUGH POWER HOUSE AND INTAKE CANAL.

the outflow of the water from the turbines. The power house will be founded upon masonry piers built upon this rock.

The construction of the power house is included in the contract for the canal and its turbines. This contract has been made with the Lehigh Construction Company, and work has been already begun at a number of points along the line of the canal and at the power house.

THE TURBINES.

The turbines to transform into moving power the weight of the column of water will be upon horizontal shafts. There will be two twin turbines upon each shaft, it requiring four turbines to produce the power and speed required. These turbines will develop upon each shaft 5,300 h. p. The turbines will be of the Victor type and contracts for their manufacture have been made with the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio.

The water from the canal enters the turbine chambers through suitable screens and after passing through the tur-

bines, is conveyed by separate passage for each set of turbines under the floor of the power house and out into the Grass River. (See Figs. 3, 5 and 8.)

The horizontal shaft of the turbines is extended through the wall of the turbine chamber, and into the power house, and still further extended in a direct line, becomes the shaft of the revolving parts of the great electric generators. Each unit of power developed is thus 5,300 h. p. transformed by the generators into 5,000 electric h. p. There will be in the portion of the power house now to be built fifteen of these systems or units of power, each of 5,000 h. p. capacity, thus developing in this power house 75,000 electrical h. p. Fig. 2 shows a plan of the power house arrangement.

The unit of 5.000 h. p. is the same as that adopted for the

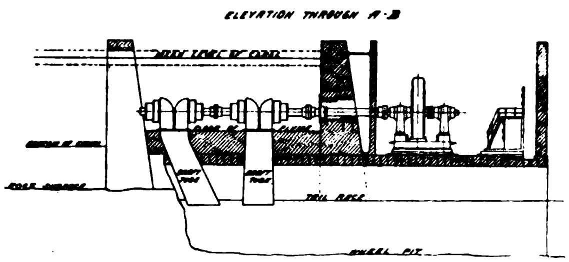


FIG. 5.—THE MASSENA ELECTRIC GENERATING PLANT.—ELEVATION THROUGH A-B.

works of the Cataract Construction Company at Niagara Falls. The construction of both the turbines and the generators is, however, quite different, the fall at the works of the St. Lawrence Company being less and the volume of water greater than at Niagara. Both the turbines and generators at Niagara are upon a vertical shaft of over 150 feet in length, while the turbines and generators at Massena are upon a horizontal shaft of about 80 feet in length.

The power house will be of good architectural design. It will rise to a height of about 60 feet above the water of the Grass River. It will have an electric crane traversing its whole length, and with lifting capacity of 85 tons. There will also be in the power house three separate turbines of smaller power, which will actuate the three exciter dynamos required for the operation of the larger generators; these are shown at the end of the building in the plan, Fig. 2.

THE ELECTRIC GENERATORS.

The 5,000 h. p. generators for the St. Lawrence Construction Company are not only of large size, but they involve a new design, and are in many ways different from other machines. Each of these great machines will weigh about 350,000 lbs., the weight of one piece being as great at 125,000 lbs. The machines will stand 22 feet high above the top of the foundations, and each machine will occupy a floor space of 22 x 18 feet.

The machines, illustrated in Figs. 6 and 7, have horizontal

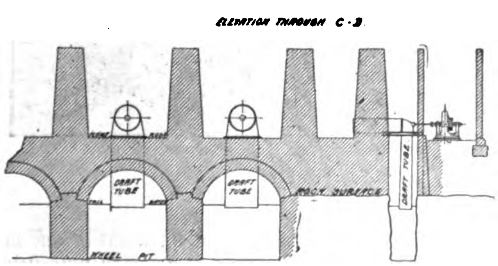


FIG. 8.—THE MASSENA ELECTRIC GENERATING PLANT.—ELEVATION THROUGH C-D.

shafts, which are in line and are directly connected with the shafts of the water wheels by which they are driven. The shaft carries a great ring of steel, which is similar to a large and heavy flywheel. This steel ring carries at its circumference twenty external projecting pole-pieces. The ring and the pole-pieces are of one solid casting of steel, the ring having an extreme diameter of 15 feet and a width of about 3 feet. It is supported from the shaft by a massive cast iron hub with ten radial arms. The steel for the ring is designed for very great strength; it revolves at a speed of nearly two miles a minute and the centrifugal force is such that each pound at the circumference tends to fly outward with a force of nearly 100 lbs. The speed of the machine is 180 revolutions per minute.

This great steel ring with the projecting poles revolves inside of a large stationary ring or cylinder, whose inner surface is made of plates of thin, soft steel on edge. These thin steel plates are held by a massive outer ring of cast iron, which has a total height of 22 feet. The thin steel plates which form the inside of the stationary part have slots in which are laid copper bars parallel with the shaft of the machine. These bars are insulated with mica, and they constitute the armature of the machine. The pole-pieces of the revolving field magnets are wound with copper strap coils, insulated with mica. The currents generated are three-phase, with 3,600 alternations per minute. The generators are now being built by the Westinghouse Company, at Pittsburg.

TRANSPORTATION FACILITIES.

The town of Massena is an ideal center for manufacturing purposes, with excellent railway facilities afforded by the New York Central and Grand Trunk lines, which meet at that point, while the Vermont Central is only six miles away, and it is understood that they contemplate building up to this new manufacturing center.

The head of the canal will be protected by gates and will be so arranged as to permit the passage into the canal of large lake vessels. Should it be deemed desirable in the future to erect a lock at the foot of the canal below the power house, this would give a passage for vessels around the Long Sault rapids of the St. Lawrence.

The St. Lawrence River is divided into two branches by the Long Sault island, which island is in the State of New York, the international boundary being in the center of the channel north of that island. The water of this power canal is thus taken entirely from that part of the St. Lawrence River within the boundaries of the State of New York. The volume of water passing down this channel is very great. The use of the water for this power does not in any way interfere with navigation, as it is returned to the St. Lawrence River directly below the rapids. Navigation on the Canadian side is provided for by the Cornwall canal, which extends from above the rapids to some distance below them, at the town of Cornwall, Canada.

FINANCIAL.

The St. Lawrence Power Company is a corporation organized under the laws of the State of New York, with a capital stock of $6,000,000. The officers of the company are: William C. Lane, president; S. H. Gardyne Stewart, vice-president; Carlton H. Reeve, secretary, and William C. Cox, treasurer. The company is owned jointly by the English syndicate, who are represented in this country by Messrs. Seward, Guthrie & Steele, New York, the well known firm of solicitors, and Messrs. Stewart & Co.

Bonds to the amount of $3,000,000 have been issued, with the United States Mortgage and Trust Company, of New York, and Messrs. Matheson & Co., the London bankers, as co-trustees. The bonds have all be taken in London by the syndicate above referred to.

Work has already commenced and will be finished by December, 1898. A large majority of this power has already been taken by a syndicate, who propose to use it principally for electro-chemical manufacturing purposes. The indications are that little, if any, of the power will be available for transmission, the demand for its sale being such as to justify the belief that it will all be used upon the premises.

In face of the adverse opinion existing in England in relation to the American securities, it is gratifying to know that Messrs. Stewart & Co. have succeeded in interesting London financiers in this most excellent enterprise, and is a long step in the direction of regaining that confidence which has been so unnecessarily lost.

The engineering work of the company is under the charge of John Bogart, of New York, and Messrs. Kincaid, Waller & Manville, of London, as consulting engineers.

"ABOVE ALL THINGS, PRACTICAL."

Mr. J. H. Winfield, of the Nova Scotia Telephone Company, Halifax, N. S., writes us: "I must congratulate you on the prevailing excellence of your magazine. It is above all things practical, which quality is the one most to be desired for the everyday engineer."

KEENE, N. Y.—The Keene Gas Light Company intends to put in an electric light and power plant transmitting current from Spragueville, and using probably the three-phase system. During the day the current will be used for power purposes.

MRS. ISABELLA FIELD JUDSON has presented to the National Museum at Washington a number of Field submarine cable relics and documents.

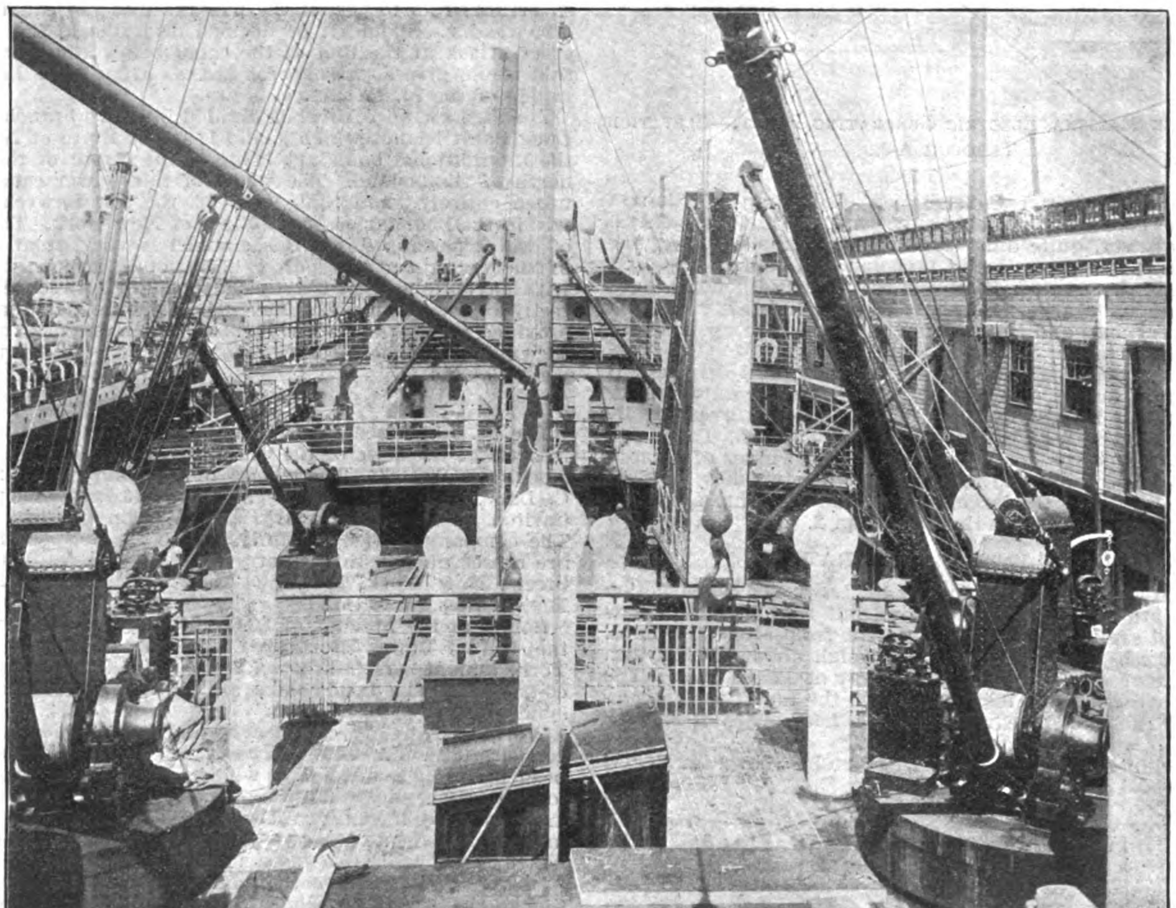
THE ELECTRIC CRANES ON BOARD THE S.S. "BREMEN."

THE steamship "Bremen" of the North German Lloyd Line, which recently made her first transatlantic trip, is, perhaps, more fully equipped electrically than any other vessel of the merchant marine in the world. Aside from the usual electric lighting plant, she has a very complete and most novel power plant, the successful operation of which is now fully conceded.

The first power installations on the steamers of the North German Lloyd were made by the Union Electricitäts Gesellschaft, of Berlin, the German ally of the General Electric Company, on the steamships "Darmstadt" and "Prince Heinrich." In these two cases the familiar and noisy donkey engine was superseded by electrically operated winches, and it was the successful operation of these that determined the North German Lloyd to extend the use of electricity to the "Bremen." In this case, however, in lieu of winches, a full equipment of electric cranes was installed. These cranes are sixteen in number, eight on the starboard side of the vessel and eight on the port side. Four of these have a capacity of 3,000 kilograms, or 6,614 lbs., and twelve of 1,500 kilograms, or 3,307 lbs., and have a total swing outboard of 20½ feet.

The power generating plant is located in the after portion of the engine room, and consists of four dynamos, each directly connected to its own engine. Two of these are placed on the starboard side and two on the port side. The dynamos have each a capacity of 75 kilowatts, or 100 h. p., and run at a speed of 210 revolutions per minute, delivering current at a pressure of 105 volts. The output of two dynamos is used for the cranes; one is used for the lighting of the ship, and the fourth dynamo is held in reserve in case of accident or other emergency. The engines are of the triple-expansion type and were built by Schichau, of Elbing, near Danzig.

The most notable feature of the electrical equipment is the cranes, the lighting installation conforming to the standard practice. In designing the cranes, the principal requirements specified and obtained were as follows: The load should be lifted smoothly; the resistance should be so arranged that the various speeds of the motors should be obtained without too sudden change; the control of the different motions should be instantaneous and positive, these motions to be effected in the smallest possible space; the cranes to be compact and contain the smallest possible number of parts; the controlling mechanism to be of the simplest to suit the class of operator likely to handle them, and the electrical apparatus to be absolutely protected against changes of weather, inroads of dust and sea water, and to be of such a nuture as to withstand rough handling. In addition, all conductors were to be carefully protected, and the last consideration, but, by no means, the least, on a passenger carrying steamer destined to be constantly loading and unloading, the operation of the cranes was to be noiseless. In conforming to these requirements, the Union Electricitäts Gesellschaft has produced what is the latest, and a very decided, innovation in a ship's equipment.



Electric Cranes on Board the North German Lloyd S.S. "Bremen."

The cranes, motor and controlling mechanism are mounted upon a circular iron platform, which revolves upon a pivot. This is turned by a motor of 7 h. p. running at 700 revolutions per minute, directly coupled to a worm gear, which, in turn, meshes in a gearing bolted to the deck. The loads are raised by a 25 h. p. series motor, running at a speed of 900 revolutions, and driving a special worm gear meshing into the gear of the drum. On this gear end of the drum shaft is fitted a winch head.

The controllers resemble a double street car controller about 2 feet high. They are fitted with magnetic blow-out. The contact cylinders are operated by a special mechanism actuated by a simple handle, the movements of which correspond to the movements of the load. Raising the handle raises the load; depressing the handle lowers the load, and movement of the crane to the right or left is obtained by corresponding movements at the lever. Raising and swinging movements can be effected simultaneously. So simple are these opera-

tions that the dullest stevedore can handle these cranes with ease. Motors and controllers are water-tight and dust-tight, but the cases of both can readily be opened when necessary. To give a more perfect control both motors are provided with to an extension of the motor shaft.

The difference between the large and small cranes lies in the hoisting speed. Practically both cranes are identical in electrical equipment, but the hoisting speed of the 3,000 kilogram crane at full load, 60 feet per minute, is only half that of the 1,500 kilogram crane at full load, 120 feet per minute. The movement of the jib of the cranes is 13 feet per second.

The most remarkable feature of the cranes, however, is the absolute noiselessness of their operation. During the visit paid by the writer of this to the vessel, the whole eight starboard cranes, four on the aft and four on the forward deck, were engaged in discharging cargo. Had the operation of hoisting and lowering not been witnessed, it would have been difficult to detect the fact, had it been necessary to depend upon the ear. It is this feature that will recommend the electrical crane to shipbuilders, especially those of passenger steamers in such trades as that of the Mediterranean, where loading and discharging is effected at every port, and great credit is due the North German Lloyd Steamship Company for first effecting this great innovation.

TELEPHONY AND TELEGRAPHY

THE STROWGER AUTOMATIC TELEPHONE EXCHANGE, AUGUSTA, GA.

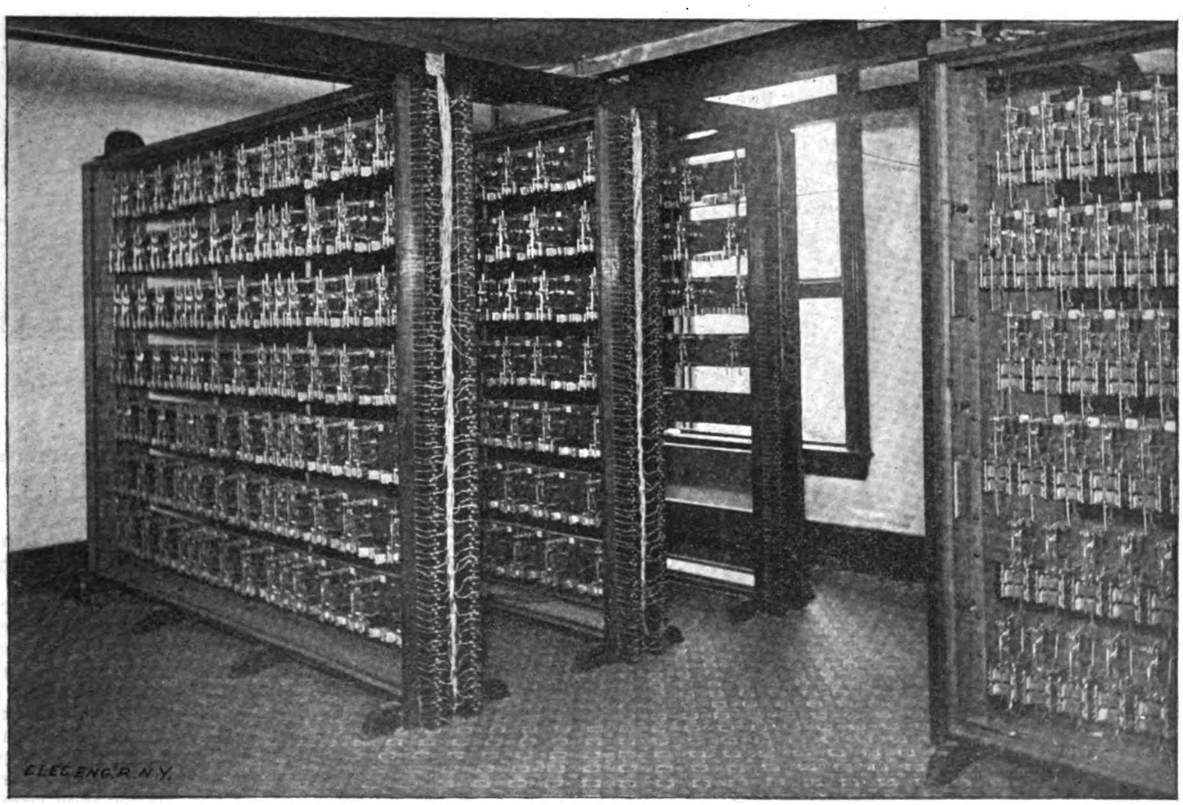
THE exchange of the Augusta Telephone and Electric Company, of Augusta, Ga., is probably one of the greatest novelties existing in the way of telephone exchanges, and is said to be the largest automatic telephone exchange in the world.

The offices of the company are on the fifth floor of the Jarvis-Conklin Building which is situated in the heart of the city. The construction of the lines was commenced February 15, last. Three hundred and fifty subscribers are now in operation and contracts are in hand for 250 more, and the lines are being pushed towards the outlying portions of the city. Hard drawn copper wire No. 14 B. & S. is used throughout the system, every subscriber has a complete metallic circuit, and all instruments are equipped with long distance transmitters.

A great deal of cable has been used in order to avoid chances for trouble and to cut down the expense of making cuts while running wires for new subscribers. The cables are the dry core paper cables with braid over lead covering, manufactured by the Standard Underground Cable Company. Trolley lines and lighting circuits have been avoided as much as possible in laying out the lines and the longest circuits are practically free from induction and other disturbances both night and day.

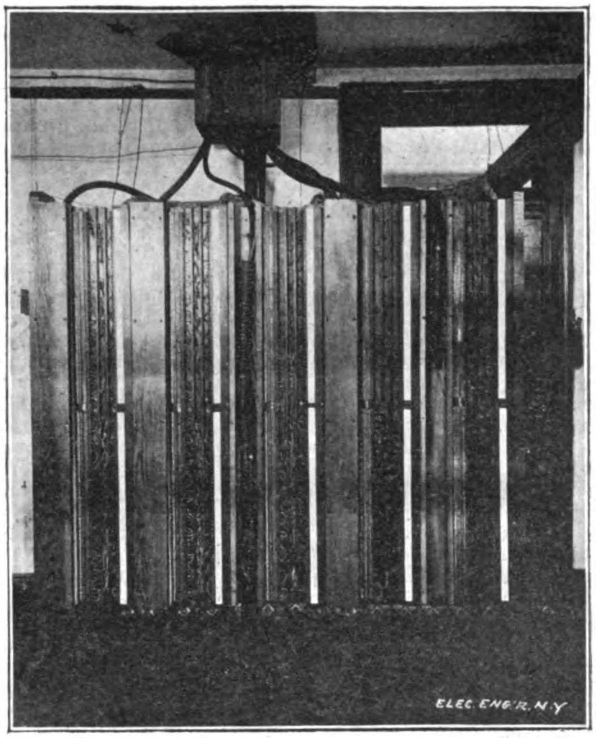
But the feature of the system which puts it in striking contrast with any system of the size is the switchboard. The telephone operator is done away with and the connections are made by the machines and system of the Strowger Automatic Telephone Exchange of Chicago. These connecting machines or switches are operated by means of electro-magnets which receive current from a storage battery at central through circuits manipulated by the subscribers at their telephones. One leg of the battery at central is a wire which extends over the entire system and taps into each subscriber's station. The other end of the battery connects through the electro-magnets of the switches to the bare wires of the subscriber's metallic circuit. Thus both ends of the central battery are furnished at the telephone, and by making contacts between the common feeder wire and the terminals of the bare wires which are called the "units" and "tens" lines, respectively, impulses are sent through the magnets of the machine at central.

These contacts are made and regulated by means of the numbered disk on the face of the telephone. This disk is pivoted at its center, and to call a certain number, the subscriber places his finger in the projections opposite the successive figures of the desired number, and turns the disk until his finger comes against the stop. That is, to call "386," the "3" would be pulled down to the stop and the disk allowed to return to its original position, then the "8" would be pulled down and the disk allowed to return, and lastly the "6" would be pulled down.



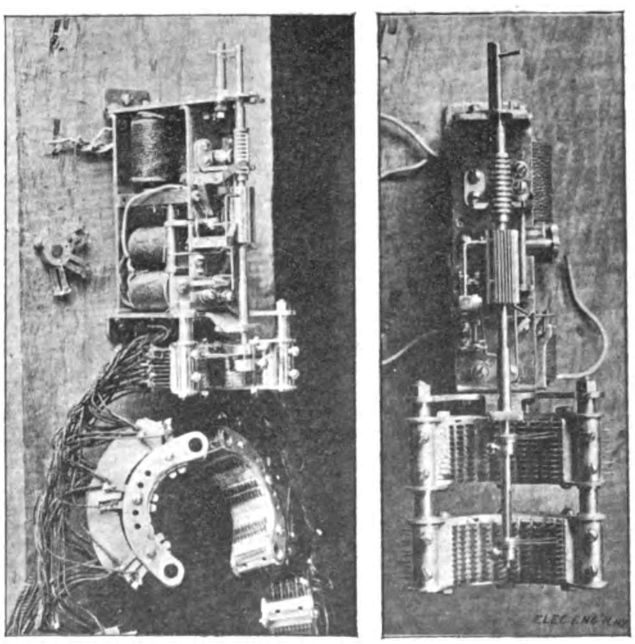
THE STROWGER AUTOMATIC TELEPHONE EXCHANGE, AUGUSTA, GA.—VIEW OF PRIMARY SWITCHBOARDS AND A PORTION OF A SECONDARY SWITCHBOARD. HEIGHT, 6 FT., LENGTH, 9 FT. 6 IN., DEPTH, 14 IN.

After each movement the disc is returned to normal position by means of a clock spring, and during the return movement it makes as many contacts as there are units in the number pulled down. That is, after the first movement in calling "386" the returning disk would make three contacts



DISTRIBUTING BOARD. CAPACITY, 1,000 WIRES. LENGTH, 7 FT., HEIGHT, 6 FT.

between the terminal of the unit line and the feeder terminal and thus send three impulses over the unit line to central. On the second movement of the disk eight impulses would be sent over the tens line to central and on the last movement six would be sent over the unit line again. This operation of



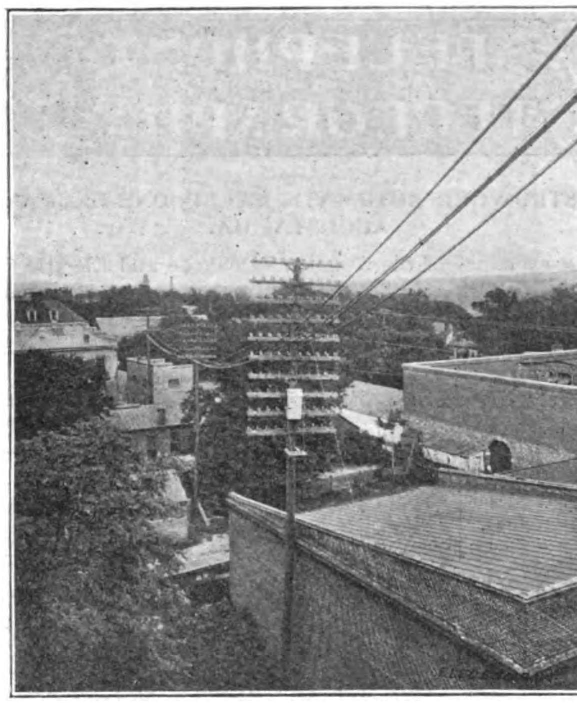
Single Primary Switch, Showing Banks and Wipers. *Single Secondary Switch.*

THE STROWGER AUTOMATIC TELEPHONE EXCHANGE, AUGUSTA, GA.

making the connection requires on the average from three to four seconds, and having finished it, the subscriber rings his bell and waits for the party called to answer. If his bell does not ring he knows that the party he wants is "busy" and he calls again in a few minutes.

The machines at the central office consist essentially of two sets of electro-magnets. One set is called the "unit" magnets and the other set is called the "tens" magnets, corresponding to the unit and tens lines just mentioned. Each set of magnets operates an armature which carries an arm with a pawl, which meshes with a ratchet hub on the shaft of the machine. One pawl moves the shaft in a longitudinal direction and the other revolves it. This shaft carries a set of spring wipers which make contact with the contact points shown at the bottom of the machine. These contact points are arranged in vertical and horizontal rows so that each movement of the shaft in a longitudinal direction carries the wipers up one row of contacts, and each movement of the shaft as it revolves carries the shaft around from one row to the next. So by properly regulating the impulses sent through the magnets by closing the circuits at the telephone the wipers can be set on any desired contact and thus connected to any desired "bank wire."

There are two sets of these machines or switches, one, called the primary switch and the other the secondary. A subscriber operates the same primary switch no matter what number he calls, but the secondary switch he operates depends



A TELEPHONE LINE BACK OF BUSINESS HOUSES FACING BROAD ST., AUGUSTA, GA.

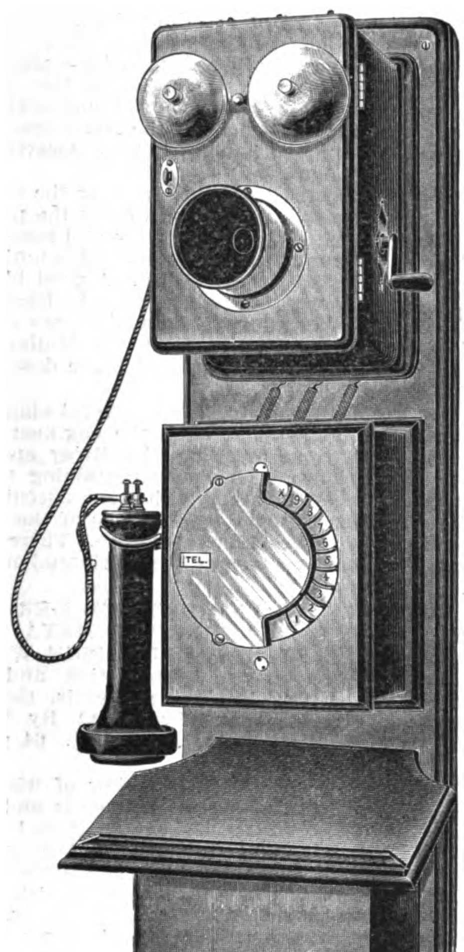
on the hundred he calls. He operates a certain secondary switch when he calls a number commencing with one hundred, another when he calls a number commencing with two hundred, and so on. The primary simply serves to select the secondary switch. So the primary is operated by the first set of impulses sent from the subscriber's station and the secondary by the last two sets.

The wiper contacts on the primary switches are arranged in three vertical double rows and the shaft carries three double wipers. The hidden ends of the contacts in one vertical row of one pair of rows are connected to the unit magnets in the respective secondary switches. The contacts of the other row of the same pair are soldered together and connected to the unit line. Hence when the double wiper comes on any pair of these contacts it connects the unit line through to the unit magnet of the secondary switch. Similarly a second pair of contact rows are used to make the connections from the tens line through to the tens magnets of the secondary switch, while the third pair of contact points are used in making the connections for the private attachment, which is explained later.

For example, if "386" is called, the first three impulses carry the wipers up opposite the third horizontal row of contacts. The first impulse of the "8" turns them in on the contacts, thus connecting the lines through to the three hundred secondary switch and at the same time cutting out the mag-

nets of the primary switch. The remaining seven contacts of the "8" are thus made to send current to the secondary switch, whose shaft carries two wipers. These wipers are carried up opposite the seventh row on the upper and lower banks respectively. Then the six impulses turn them about to the sixth contact in the horizontal row. This places the upper wiper on contact "86" in the three hundred bank and completes the connection. The hidden end of each contact in the section is connected to an individual line whose number commences with "3."

The lower wiper is called the private wiper. If a second subscriber calls the same number while the first subscriber is still talking, when his private wiper comes on the same contact as that of subscriber No. 1, a circuit is hereby closed through a third magnet on the switch thus operating an armature which opens the last subscriber's line and prevents him from cutting in on the conversation already in progress. After a subscriber is through talking he simply hangs up his receiver and as the hook comes down contacts are made between the battery feeder and the unit and tens lines in such a way that the magnets at central operating on their armatures release the shafts of each machine and a spring returns each shaft to its normal position ready for another call.



THE STROWGER TELEPHONE TRANSMITTER.

A storage battery of 48 cells of 40 ampere-hour capacity operates the switches. The battery is re-charged in the evening, but the re-charging does not interfere with the operation of the exchange.

One man attends to everything about the central office during the day, and after ten o'clock at night and on Sundays the exchange is locked up. All lines are tested every morning for breaks, crosses and grounds by using a few cells of the central battery for a test battery. The tests only require a few moments and do not annoy the subscribers in any way. All telephones are inspected on an average, once a month.

The points about the system which are especially worthy of notice are: the great speed and simplicity with which connections are made, the small number of wrong connections, the opportunity to ring a subscriber's bell until he is compelled to answer the call, the absence of cross talk and induction from the lines, the absolute privacy of each conversation and the chance to do business over the wires without interference from operators or other subscribers.

Such a system as that put in at Augusta is more costly than most of the opposition exchanges have been, but the officers of the company realize that to compete successfully first class service must be given and that such service cannot be maintained at a small cost without using the best of material and good instruments. Good material and good workmanship are as quickly appreciated by both patrons and stockholders of a telephone system as in any other business enterprise. And a pleased patron is always a company's best advertisement—a very old but a very truthful saying.

The exchange is under the able management of Mr. P. D. Langdon, with Mr. Lee Campbell, superintendent.

THE BABCOCK MARINER'S ELECTRIC SOUNDER.

THE Lloyds in estimating the causes from which all kinds of ocean craft have met their fate in the past 15 years assign 44 per cent. of such causes to strandings, because of fog, darkness, etc., in unknown depths of water, but at a time, of course, when the craft's officers imagined that their vessel had plenty of water under its keel. To place in the hands of mariners an apparatus which will enable them to ascertain with ease and certainty the depth of water under their vessels, Dr. J. F. Babcock, of Bangor, Me., has recently devised the electric sounding outfit illustrated in the engraving, Fig. 1; the sounder is shown in section in Fig. 2.

An iron ball, with a rod or standard attached, is suspended at the bottom of a cylinder by the rod passing through a hole in the bottom of the cylinder, which is rendered water tight by a rubber cap that moves with the rod as it passes in and out, the rod connecting with a spiral spring inside the cylinder.

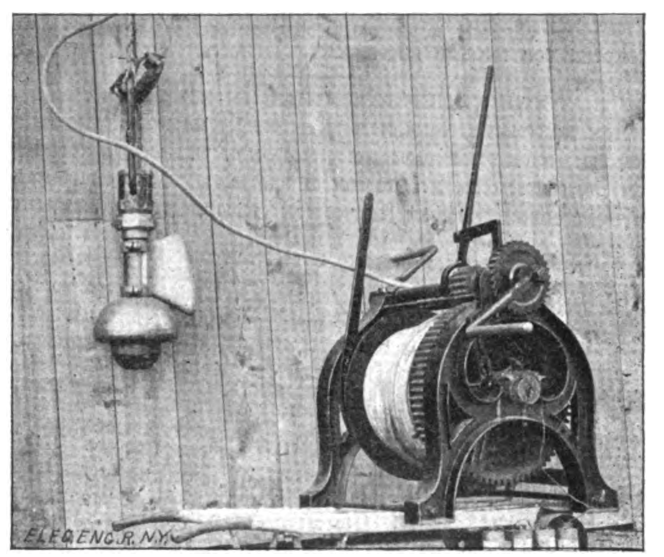


FIG. 1.—THE BABCOCK ELECTRIC SOUNDING OUTFIT.

When the ball is suspended, there is a space of about one-sixteenth of an inch between the upper end of the rod and the ends of the conducting wires, and, when the ball and rod is pushed up through that space, the ends of the wires are connected, completing an electric circuit. When the cylinder is towed at the end of the cable, from the bow of the vessel, at any given depth of water, the ball strikes the bottom when the water has become that depth shoaled, and is raised to make the connection of the wires in the suspending cable, which sounds an alarm on board the vessel. The winch shown in Fig. 1 carries 300 feet of cable. The latter, which was made by the Simplex Electric Company, is sufficiently strong to bear a strain of 7 tons.

The fan or rudder device seen on the sounder is designed to overcome any rotation or twisting of the cable when dragging through the water. The electric action of the sounder is so sensitive that no matter what the position of the sounder is when it touches the bottom, or when, for an instant the strain is relaxed upon the cable, the connecting bells will ring.

The winch carries a commutator at the axle point at the side exposed in the engraving, and the corresponding point at the other end of the axle carries a cyclometer showing the

number of fathoms of cable that have been paid out. The winch crank can be turned either way without disturbing the current.

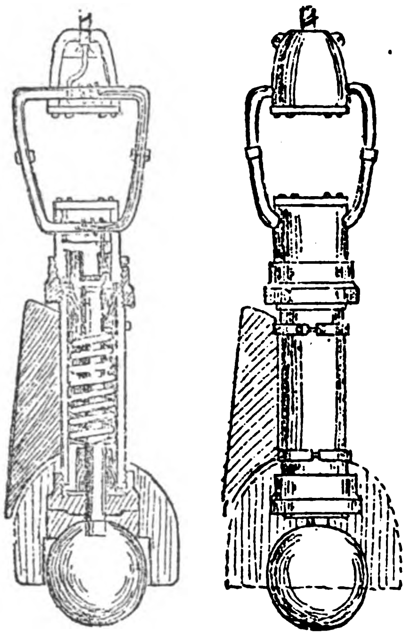


FIG. 2.—THE BABCOCK ELECTRIC SOUNDER.

It goes without saying the apparatus is also particularly adapted for marine surveys.

THE TELEPHONE WAR IN ST. LOUIS.

"Six hundred thousand dollars for undergrounding; $1,000,000 for general extension of business." That is the way General Manager Geo. F. Durant, of the Bell Telephone Company of Missouri, puts the increase in the capital stock of that company from $400,000 to $2,000,000. Mr. Durant was asked if the increase did not have something to do with the prospective fight with the Kinloch Telephone Company.

He smiled contemptuously and said: "The Kinloch Company's affairs have not influenced us in the slightest degree. We have talked of this increase of capital for over two years. We have needed money for the general extension of our business and of the $1,600,000 increase $1,000,000 is for the purpose mentioned. The undergrounding will cost, with its incidental changes in wires, switchboards, new instruments, etc., about $600,000. That is the whole thing concisely."

Nevertheless there are those who look upon the million dollar "general extension" fund as being much like the business end of a bee—always ready. One gentleman, who would not talk for publication if his name were given, said to a "Star" reporter that the Bell company was getting into a position to meet all comers; that the $1,000,000 was for general business, but that general business was of such a character as would make the situation interesting. This gentleman, who is in a position to speak by the card, said that if it became necessary the Bell company would put up such a fight as has never before been seen in a telephone war. The Bell company would not show its hand until the real fight was on—that is, until the new company was prepared to give service, of whatever kind it may have. Then the assault at arms would be a fierce one, it being intimated that a killing cut in rates would be the method adopted.

The situation was thus described: "It will be necessary for the Bell company to make an example of the Kinloch company to prevent wars in other towns. Wars are expensive, you know, and a crushing defeat here is the only thing that would prevent speculators in other towns from starting rival exchanges with the purpose of effecting a sell-out at a round profit. For this reason the Bell company will make bitter war on the Kinloch company when the time comes, for it must be settled now which is to be supreme in St. Louis, else the Bell company will be made a mark in every town in the country.

"It would be cheaper to spend millions even here to crush a rival than to be drained dry in every town in the country. which would be the case should it be demonstrated that headway can be made here with a rival exchange."—St. Louis Star Sayings.

LITERATURE

THE APPLICATION OF ELECTRICITY TO RAILWAY WORKING.—By W. E. Langdon. New York: Spon & Chamberlain. 1897. 331 pp. 5½ x 8½ in. 142 illustrations. Cloth. Price, $5.

The first impression gained from a glance at the title of this work might lead the average American reader to infer it refers to the operation of electric railways, but a glance within the covers of the book would soon disabuse him of that opinion. As a matter of fact the work is devoted to the description of methods of electrical control of railway trains, including signaling, switching, etc., with brief reference to the lighting of trains and yards.

In carrying out his plans the author gives complete details, first, of the method of erection of a railway telegraph line, with very complete details both illustrative and descriptive of methods of construction. Some of the photographs of English railway lines which we notice in the work are in strong contrast to the same class of work met with on American railways, and for the benefit of the latter one might wish that the work were in the hands of every American railway telegraph superintendent.

In the chapters devoted to block signaling the author takes up the various systems in use in England at the present time, among them the block signaling systems of Preece, Tyer and others. Among the automatic systems we also notice the Hall system, employed in the United States. A good idea of what has been done in the way of train lighting in England can be gathered from the description of the equipments employed on the London, Brighton & South Coast, the Midland and the Great Northern roads in England, which are described in detail.

The author has done well to devote several chapters to the subject of administration, including the engineering branch, the duties of the various officers and railway employés, etc. We also notice various check sheets pertaining to the work of the train dispatcher, together with other useful tables and blanks. Taken altogether, the work is one of the best of this kind which has yet come under our notice. There is much in it that American railway telegraph superintendents will find of profit.

ENTWICKLUNG, BAU UND BETRIEB DER ELEKTRISCHEN OFEN ZUR GEWINNUNG VON METALLEN, CARBIDEN UND ANDEREN METALLURGISCH WICHTIGEN PRODUKTEN.—(Development, Construction and Operation of Electric Furnaces for Producing Metals, Carbides and Other Metallurgically Important Products.) By W. Bochers. Halle a. S. Wilhelm Knapp, 1897. 5½ x 8¼. 64 pp. Paper. Price, $1.

This little volume is an excellent review of what has been accomplished in the way of producing metals and other metallurgical products by means of heat generated electrically. The author divides his subject under two headings, describing under the first furnaces depending upon the heat generated by the resistance of conductors, and, second, by the heat obtained from the electric arc. The illustrations, which are throughout very clear, show the types of nearly all furnaces which have thus far found employment in practice or have been suggested. We also notice several valuable practical tables relative to the density of current in furnaces employing carbon rods, both as heat producing resistances and as the electrodes for the arc.

INTRODUZIONE ALLO STUDIO DELLE APPLICAZIONI ELETTRICHE.—(Introduction to the Study of Electrical Applications.) By M. Ascoli. Published by Elettricista. Rome, 1897. 312 pp. 6½ x 9½. 123 illustrations. Paper. Price, $1.75.

This work is in the nature of a text-book, designed to present to the student the principal theories on which electrical work of to-day is based. The author presupposes the student to be fairly well equipped mathematically.

DIE ELEKTRICITAET UND IHRE ANWENDUNGEN.—(Electricity and Its Application.) By Dr. L. Graetz. Stuttgart; J. Engelhorn, 1897. 556 pp. 6 x 9 in. 365 illustrations. Paper. Price, $2.80.

This is an excellent work, giving in simple language descriptions of modern electrical apparatus employed in electrical transmission of intelligence, power, electrical illumination, etc., and the theory upon which it is based. While not entering into abstruse theories the information given is always strictly accurate, and it is one of the best popular technical works that has come under our notice.

LETTERS TO THE EDITOR

THIRD RAIL EXPERIENCE.

As a constant reader of The Electrical Engineer, I would like to ask about the "third-rail" system as used by the N. Y., N. H. & H. R. R. Co. On reading your issue of June 2, and, in fact, several previous issues, I have formed an opinion of the "third rail" used by the above company, as being a subject that will bear some considerable discussion.

I think that President Clark deserves a great deal of praise; he is apparently "up to date," but it seems to me that he has not been well advised in some of his electrical ventures. Why is it that we never hear of any of the bad things in connection with the "live rail"? In the description of this rail in the issue of June 9, I am sure that the writer is greatly mistaken in many of his statements.

He says that handling 600 volts is attended with some risks and goes on to say that a large conductor makes it quite safe. It seems to me that, considering the position of this rail, 600 is not a low voltage and putting the steel rail on equal footing with copper, it is not an extra large conductor. The idea that a large conductor is safer to handle than a small one seems to me to be something "new." Will the chief electrician of the company explain this point, or is it beyond explanation? He speaks of years' experience with the third rail; if I am informed correctly the third rail has been in service but one summer and has not been tested during the winter.

I can find no record of a cloud burst in the weather bureau's files, although it may have escaped their notice. Then, again, he says that short circuiting is unknown in the years' (?) experience at Nantasket. Is this a fact? If it is, what was the cause of the burning up of so many circuit breakers last season? I think if H. K.L. will take the troble to get reliable information on this subject, he will find that it is just the opposite to his statements. In fact, it was almost a daily occurrence to replace one or more circuit breakers used on the third rail. Also about workingmen getting "shocked," it may be a nice thing to call it "muscular contraction," but it was a decidedly different thing to the victim.

INNOMINATO.

THE DISCUSSION OF PLAIN IRON CONDUITS.

Will you permit a casual but interested reader a few words in criticism of "Jim Crow's" recent article upon the subject of Plain Iron Conduits.

It appears to me that his attack upon the consistency of those who advocate the use of uninsulated conduits in lieu of the insulated article is not only uncalled for by the facts presented, but is not justified by his argument. In order to make a prima facie case against such advocates he is compelled to assume that the men who have of recent years "put forth an incalculable amount of energy in creating and codifying rules which have the one word 'Insulation' as their sole foundation," have themselves correctly apprehended the right lines of "Safe Construction," and that all who hold or think that insulation is not a prime factor are necessarily in error. From these premises your correspondent is, of course, easily able to indict those who now advocate the use of uninsulated conduits as guilty of "inconsistency" and of "taking a long step backward"—particularly when, as in the case he cites, he is able to lay to their charge the absurdity of interrupting the continuity of the conducting envelope by the occasional insertion of an insulating joint. Your correspondent would appear to be incapable of making due allowance for the befogging influence of habit—else he would not condemn the advocacy of a revolutionary reform because, forsooth, a clear perception of its full scope is not immediately had by its advocates. Such apparent inconsistencies are the inevitable concomitants of all reforms, a clear recognition of the inutility of certain inherited accessories is seldom had except through long experience.

Let us. therefore, cease cavilling and inquire simply as to which is the safer conduit for electric conductors, insulated or uninsulated. This is, after all, the sum of the matter in so far as it comes within the purview of the underwriters.

In the argument for uninsulated conduits there must necessarily be assumed an insulation upon the conductors themselves, sufficient to insure a reliable and durable service. The only question involved in this assumption is as to whether the wire insulations of commerce can and do afford the requisite reliability. The contention, of course, is that they do. If this contention is well founded, then no auxiliary insulation is essential for this specific purpose and the whole subject is reduced to a question of relative safety.

In promulgating the decree that conduits are merely wire raceways and must not be depended upon for insulation, and in the logical supplementing of such decree by the further one permitting the use of uninsulated conduits, the underwriters have apparently concluded that the insulation of a conduit adds nothing to its efficacy as a safeguard against fire.

Upon this crucial point I observe that your correspondent does not touch. He simply assumes that insulation being admittedly a necessity somewhere, its multiplication becomes an added safeguard and ergo, any subtraction is inconsistent, illogical and foolish. Is this a justifiable assumption? That is what the inexpert would like to know. If it is not, then your correspondent is wasting his powder by firing in the air. If it is, then those to whom is entrusted the important duty of regulating the use of electricity have been culpably careless in relaxing their vigilance, and may very properly be held responsible in the event of serious results.

Perhaps, Mr. Editor, "Jim Crow" may be willing to throw some light upon this important element of the interesting and valuable discussion. "DOE BIRD."

New York City, July 30, 1897.

THE FUTURE OF THE FAN MOTOR.

The editorial in the July 8 issue of The Engineer on fan motor work has interested us very much. We agree with you on nearly all of the points which you make especially with reference to the advantages of using them in hotels and similar places. The fan motor has evidently passed the stage of being a luxury entirely, and is now being used as a necessity, and, of course, when the general public becomes acquainted with their many merits, and the fact that even in the hottest weather, a good night's rest can be obtained by their use, we believe they will become as general as the use of ice or fly screens.

We have been operating our factory both night and day for the past two or three months upon fan motors, and have been unable to keep up with the demand, and we believe this great demand is largely caused by the fact that people are buying them for home use. Instead of its being a rarity for a person to have a fan motor in his residence, it has now become a regular thing for a person to order two or three at a time for this purpose, as it is found that with fan motors at the present prices the labor of carrying them from room to room is burdensome, and it is much easier to have one in each room where they expect to use them. The fan motor, like everything else, is being improved each year both in cheapness and in quality, and we are inclined to think that in the course of a few years, we will have fan motors which are perfectly noiseless and which can be operated with perfect satisfaction in the quietest bedroom or sick room.

C. R. MESTON,
Secretary The Emerson Electric Mfg. Co.
St. Louis, Mo.

THE CONDITION OF BUSINESS FROM A PRACTICAL STANDPOINT.

It may be of interest to the readers of The Electrical Engineer to consider for a moment the general condition of the electrical business to-day. Over-production combined with over-zealous competition has placed the manufacturers in the electrical line in such a position that they are selling their goods without a profit. This condition exists in all branches of the line, not excluding the electrical contractors, who have been and are now accepting contracts in which there is not a legitimate profit, speculating on extra work to yield them a profit.

The result of this is obvious. Credits have been weak, and the bankers are exercising more care in discounting their paper. The dealers and manufacturers have less capital in their business, and contractors are unable to meet their payments promptly. And all this we can attribute to the demoralized condition of the electrical business to-day.

The question is, "What remedy have we?" Undoubtedly some of the readers of your valuable paper can offer some suggestions. A SUBSCRIBER.

New York City, July 31, 1897.

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THE PRECISION OF ELECTRICAL ENGINEERING.

THE failure to answer satisfactorily the question, What is Electricity? is usually counted against the electrical profession not only by those whose reading extends no further than the daily newspaper, but by those whose education ought to make such a question superfluous. The inability to answer the question has, however, instilled in the mind of the layman the idea that electrical science and the electrical arts are based on guesswork. As Prof. F. B. Crocker in his inaugural address before the American Institute of Electrical Engineers very happily puts it, the life of the electrical engineer is supposed to consist of a series of surprises and shocks to his mind as well as to his body. "The Precision of Electrical Engineering," which Prof. Crocker chose as the subject of his address, is thus an eminently timely one. Of course, as Prof. Crocker points out, the mere fact that we do not know what the essential nature of electricity is, cuts no figure in the application of the laws of the science, any more than our ignorance of what gravity is prevents us from applying its laws. But, as a matter of fact, Prof. Crocker contended, and, we believe, with ample proof, electrical engineering not only leads all other branches in the magnitude and rapidity of its results, but also in the exactness and certainty of its results. In proof of this he points out that such men as Franklin, Faraday, Ampère, Maxwell, Henry, Helmholtz, and a long list of others distinguished in electrical science were not men whose ideas were vague or incorrect. This alone would suffice tc establish the position taken, but if to this be added the rapid progress of electrical science and its applications, then, surely, enough testimony is at hand. Electric railroading and long distance electrical transmission are the development of only ten years' work. Surely, men groping in the dark could not have accomplished such work in such a brief space of time. The location of a fault in an Atlantic cable, or the design of a dynamo guaranteed before construction to give a certain output at a certain efficiency, demonstrate sufficiently the fact that so far as exactitude is concerned, electricity is the superior of any of its sister arts. Then, again, the uniformity of electrical units throughout the world, the accuracy and ease with which electrical measurements can be made without even interrupting the circuit, whether for the largest or smallest quantities, and the portability of the measuring instruments, all indicate a high stage of development of any science. We have given but a brief outline of the proofs advanced by Prof. Crocker, but enough has been said to indicate that he has well sustained his proposition. It would be venturing too much to hope that the prevailing misconceptions, as to the indefiniteness of electrical work, will be eradicated, but Prof. Crocker's address may impel workers in other fields to revise their inchoate opinions of the electrical engineer.

GOVERNMENT TELEGRAPHS.

WE note that the New Orleans "Times-Democrat" has begun a campaign in behalf of Government telegraphs, and has not only issued circulars on the subject, but has given up a large part of its space to the discussion of the topic. The agitation is being conducted with ability and moderation, and that journal, which has kindly favored us with files, etc., in regard to the matter, appears to be waging the campaign in full sincerity and conviction as to the propriety of the change.

It was, perhaps, impossible that any new arguments should be presented in this already long discussion, and we are not surprised, therefore, to discover a lack of novelty in the data before us. Apparently the "Times-Democrat" has trouble and expense in connection with its press matter, and it also does not approve of the closing of the offices at sunset in the smaller towns. These are certainly good and valid reasons for an agitation, but are they sufficient, or are all the reasons that have ever been urged sufficient for transferring the telegraph from private enterprise to Government monopoly?

We have ventured from time to time to answer this question with a very decided negative, and can now find no basis for a change in our views and convictions. We happen to be among those who think that most governments do most things badly, and that the people are happiest and best off who manage their own affairs with as little official control and management as possible. If there is any evidence to the contrary in the history of the nations we have failed to detect it. It is true that of late political doctrines and events have gone a long way toward State socialism, which means the abolition of private ownership and enterprise, but in due time the pendulum of opinion will swing the other way, leaving people freer than they ever were before, to handle and conduct their own business, and leaving the State a minimum of functions. Just now, somebody wants the community to own all the lighting plants; another person has his mind fixed on running all the street railways and all the larger railroads; this man wants the ferries to be seized, and that one proposes to nationalize all the mines of coal, iron, silver, copper and gold. Here is a man who fights for State telegraphs, and there one who would have the State issue a free daily newspaper for everybody. And so it goes. The chance of deficit, of local and national bankruptcy, bothers no one; nor in this country do the agitators of these things remember that their forefathers came here to escape this very State ownership or direction that they are so eagerly clamoring for.

Turning to the specific topic, we may join issue with the "Times-Democrat" that telegraphy in England and Europe generally is cheaper than it is here under the Postal, Western Union and other private companies. This we deny most emphatically. If the different purchasing power of money, different rates of salary, different distances, and different methods of counting the words, are taken into account, it will be found, as has often been pointed out before, that the advantage rather rests with us, plus the advantage of having no offensive official censorship put upon what one wishes to transmit. The "Times-Democrat" publishes every week lots of dispatches that neither love nor money could get over the wires for it if it were a European journal; and the espionage is, we believe, just as close as it was when Napoleon opened every letter passing through the mails to and from Spain. In this respect, the government telegraphs of Turkey and Germany are pretty much on a par; and if they or any of the other systems pay absolutely we have still to be advised of the fact.

The "Times-Democrat" proposes to put the telegraph in the hands of the postoffice. If we are not mistaken, that service

is now run actually at a heavy loss, and, of course, the deficit must be supplied from taxation. Of late, the money has necessarily been supplied, or rendered available by part of the bond issues, as the Government has not paid its way at all for some time past. Is the telegraph to be another source of financial embarrassment for the countrty? And what about the telephone? Is that to be overlooked? And does the "Times-Democrat" propose spending about $250,000,000 in purchasing these systems, or does it propose confiscation? The postal service cannot stand free competition, and every attempt is ruthlessly quenched, as at Buffalo quite recently; but the service remains so bad that we see no hope of improvement until private enterprise gives the public a chance to telegraph its letters cheaply by some "machine" method.

We would suggest to the "Times-Democrat" that some of the energy it has notably displayed on various interesting occasions might well be devoted by itself to getting the better news system it needs. The telephone is a marvelously effective news device, for example, and it could soon create a cheap system which would give its various correspondents the ear of the editorial room every hour in every twenty-four. But unless our contemporary wants to help convert all of us, whatever we do, into State officials, we beg it to refrain. The remark of Mr. Herbert Spencer comes freshly to mind as one notes all these desires for reform through the agency of Government control: "After ceaseless ridicule of red tape, the petition is for more red tape. Daily we castigate the political idol with a hundred pens, and daily pray to it with a thousand tongues." Our contemporary disclaims and flouts the suggestion of "socialism," but we would like to ask just where it sees the difference, and just where it expects the process to stop.

HALT AND RIGHT ABOUT FACE!

FOR a long time past, the prices of electrical apparatus have been on the downward plane. They no sooner reached a low point than deeper levels were disclosed, and the last four or five years have been spent in a desperate effort to find rock bottom. It is true that prices of other raw material and manufactured product have been far below the average, ever since the great panic of 1893, but the period of four years has seen marked rallies and advances in many staples, and to-day there are few that are not firmer than they have been for some time past. When we turn to electrical prices, no upward tendency has disclosed itself, and even now when in many lines there is renewed activity, the greater volume of business does not appear to carry with it any larger margin of profit. One of our readers calls attention to this state of affairs in the present issue, and indicates a belief that remedies for unprofitable trading could be found if they were sought. At this juncture, when returning prosperity is already sending prices up, it is a timely question that is asked. No one man, or concern, perhaps, can renew good conditions, but if there were harmonious action, business could be conducted on a fair margin of profit and the public would get better treatment and better goods.

The bids on some recent contracts in New York tell the story of undue competition. We could name one plant where six bids on dynamos, wiring, etc., ranged around $60,000 and the contract went at less than $52,000. In another case the wiring was bid on at $22,000 and the contract given at $15,500. In a third case, the highest bid for a fine new plant was $126,000, and the contract was closed at $98,000. In all these instances, the highest figure would have been considered a sacrifice a year or two back. What, then, are we to think of the lowest figures. Several questions are raised. Can some manufacturers and contractors do business so much better than others? It does not seem possible. The specifications in these plants were, we believe, drawn up by highly competent experts, with the utmost clearness, and it is hard to detect where these wide margins come in. If all are pretty much on the same footing, then profits are recklessly thrown away, and the credit and stability of the industry are proportionately endangered.

We shall be glad to know what our friends think about this. If these are to be times of prosperity, should not a halt be called on price cutting and an agreement be reached which will, at least, allow a living margin of profit?

FAN MOTORS IN LIBRARIES.

ANYBODY who has had much to do with books knows that it is no easy task to keep them dusted, and extremists, in view of the difficulty, have gone so far as to assert that you should never dust books. They should be left undisturbed till needed, and then the rust and dust of ages can be taken off with a napkin. This, however, is regarded as the heresy of sheer laziness, and the practical suggestion is now made that the fan motor is the thing wherewith to banish grime and dust from a well kept library. All that is necessary is to turn the breeze loose over the shelves, with the windows open, and in a few minutes the tops and covers will show up in all their pristine freshness. Obviously the fans can be portable, and either carried around in the hand by long flexible cord or hitched up at suitable plugs and left spinning. Thus dust will not be able to settle for long and will rarely have a chance to accumulate even for a single day. Electricity has, therefore, another claim to use in libraries. Gas is well known to have a deleterious effect on books, and Mr. Blades, the well known bibliographer, once said there was nothing to equal it for rotting covers, even those of leather. With electricity, a public or private library will be better lighted and better kept, while it will also be safely available more hours of each day.

TELEPHONIC GHOST VOICES.

A VERY pretty medieval story comes from the Folsom, Cal., penitentiary. Wilson and Prescott, convicts there, formed a plan to break jail some time ago. All preparations had been made and arms had been secreted outside the walls, when the plot was discovered. Wilson and Prescott were the only men who knew where the arms were. They were starved, kept in dungeons, and even tied up by the thumbs. but without results. At length the warden decided to place them one at a time in a cell in the condemned row, known as the "haunted cell." A wire was stretched from the captain's office to the cell, attaching it to a telephone transmitter. Wilson was the first victim. He was conducted to the room at midnight and an hour afterward the warden and his men in the telephone room of the office began to mutter sepulchral threats into the transmitter. They hissed, screamed and cursed and rattled chains on the telephone box, till far in the morning. When they went for Wilson at midday they found him badly scared, but still unwilling to talk. Then Prescott was tried. After a few days he weakened and told the whole story. He was nearly crazy when taken out.

This is a very charming episode, and should offer many suggestions to the police who are trying the "third degree" on criminals, in New York or Chicago. A new line of business is opened up for telephone exchanges, and it would obviously be more sensational and effective to get an accomplished elocutionist piped on from central, than to depend thus on the crude amateur efforts at spirit mediumship, of prison wardens and turnkeys. The idea might, perhaps, be tried in schools and residences where naughty children refuse to be quelled.

STREET CAR OWNERSHIP.

A PARTY of socialists in Atlanta, Ga., are demanding that the city take possession of and operate the street railways of the city. We would like to mention an item of news for their benefit, but are afraid it won't have much effect. Several references have appeared in our columns lately to the municipal street railways of Glasgow, Scotland, and the fact has been mentioned that they earn net for the city about $45,000 a year. The population is somewhere around a million. But Newark, N. J., receives from the Consolidated Company over $100,000, although the population is not above 250,000. On the basis of population, Glasgow should have received $400,000, or nearly ten times as much as its own municipal system netted for it. We have a suspicion that this is about the way with most municipal enterprises, but Glasgow has been flaunted in the public eye so long, it is time the hollowness of its claims to humble admiration was squelched by a few solid facts.

ELECTRIC TRANSPORTATION

THE HARTFORD, CONN., STREET RAILWAY CO.

THE Hartford Street Railway Company was organized July 21, 1862, and commenced running horse cars in April, 1864, having at that time about six miles of track and operating five or six cars. During the year 1895, the whole system was finally equipped with electricity, and at the present time the company owns and operates over seventy miles of track. The equipment consists of seventy-eight closed and eighty-nine open cars. There are run daily sixty to sixty-five cars, which make 8,000 to 9,000 miles. In the year ending September 30, 1896, the cars of this company were run 2,814,072 miles, and carried 10,854,971 passengers.

LINES.

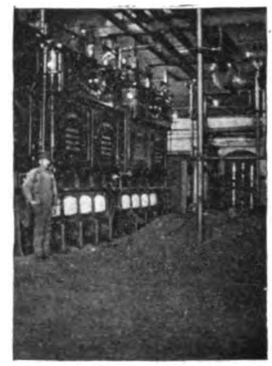
As will be seen by the map, the lines cover nearly every part of the city, and reach out to many of the surrounding towns, i. e., Wethersfield, West Hartford, Windsor, Poquonock, Rainbow, South Windsor, East Windsor Hill, Burnside, and North and South Glastonbury. At West Hartford, connection is made with The Hartford & West Hartford H. R. R. Company, whose lines extend to Farmington and Unionville. At Burnside, connection is made with The Hartford, Manchester & Rockville Tramway Company, whose lines extend to North and South Manchester and Talcottville, and a line is under construction to Rockville.

The Hartford Street Railway Company has been building a line, which opened up in June, that extends to the City of New Britain. Here connection is made with The Central Railway and Electric Company system, whose lines extend to Berlin and Plainville, there connecting with the Bristol and Plainville Tramway Company, with lines to Bristol, Forestville and Compounce Pond.

POWER HOUSE.

On May 2, 1894, it was decided to purchase from the Woodruff and Beach Iron Works the property No. 72 Commerce street.

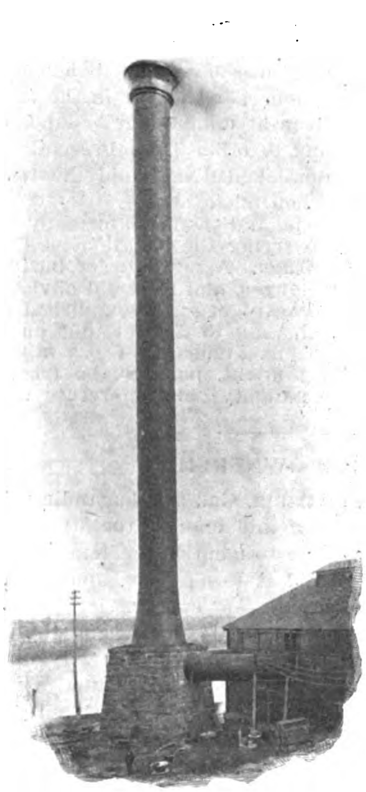
POWER HOUSE DURING FLOOD, MARCH 3, 1896.



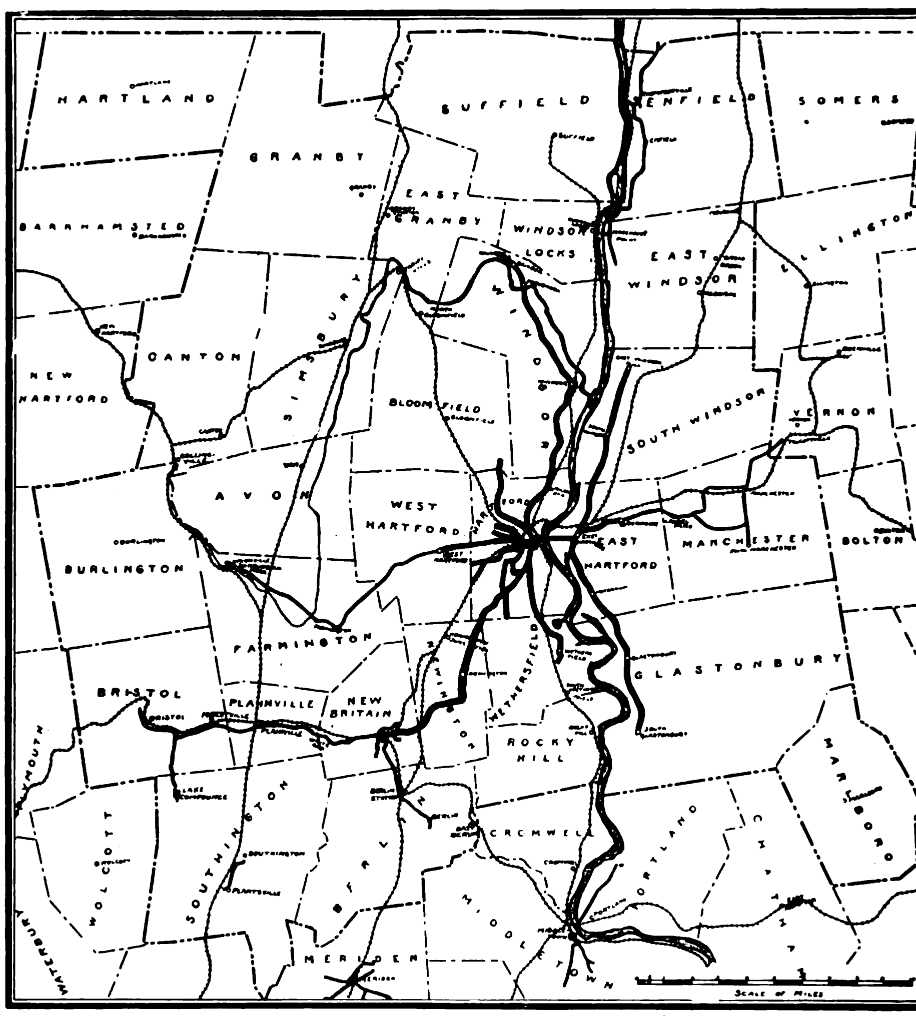
BOILER ROOM.

Owing to the annual floods in the Connecticut river, it was necessary to locate the engine and boiler rooms at a safe elevation above the highest known flood, which, on May 1, 1854, reached the height of 29 ft. 10 in. above mean low water. The accompanying illustration of the power house shows the front, with a flood of 26.5 ft. above low water on March 3, 1896.

In order to exclude the water from the portions of the build-



CHIMNEY.

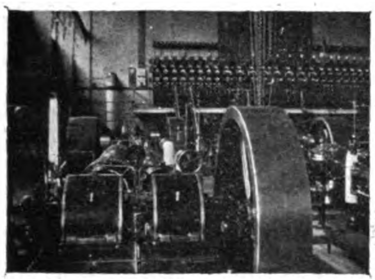


MAP OF HARTFORD AND SUBURBAN RAILWAY SYSTEM

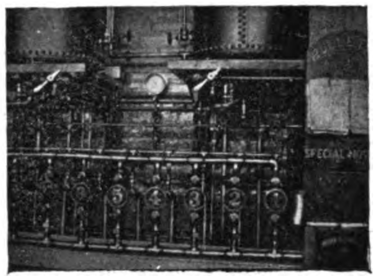
ing below the high water marks, principally the condenser pit, the bottom of which is only 11 feet above low water, it was necessary to re-enforce the old foundry foundations with a concrete wall 12 inches thick. This device has been most satisfactory.

The power house is a brick and iron building, 230 ft. x 63 ft., built by the Berlin Iron Bridge Company. The third section, which is 65 ft. x 63 ft., is divided into offices, stock room, work shop and wash room for the employés.

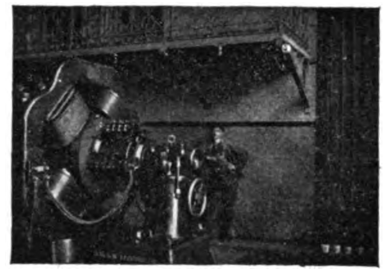
The engine room occupies the middle section, with a floor space of 100 ft. x 63 ft. The floor is composed of 4-inch yellow pine, covered with 1⅛-inch maple, supported by 12-inch I beams. The room is spanned by a crane of ten tons capacity, built by the Berlin Iron Bridge Company. The third section, 65 ft. x 63 ft., is the boiler room.



ENGINE ROOM.



OIL DISTRIBUTING APPARATUS.



GENERATOR.

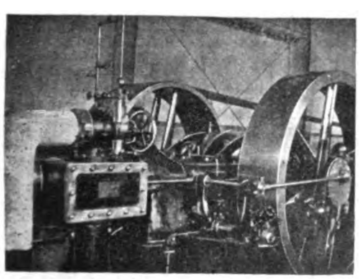
ENGINE ROOM.

The engine room equipment consists of eight 300 horse-power, cross-compound, condensing, Ball and Wood engines; eight M. P. 220 kilowatt General Electric generators; four 12 in. x 15 in. x 10 in. Worthington independent jet condensers, and two 9½-inch Westinghouse air pumps.

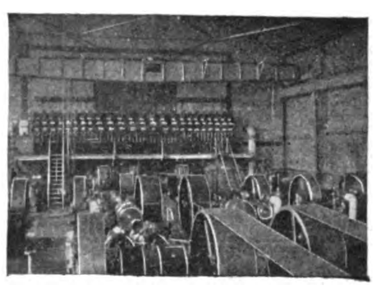
The principal dimensions of the engines are: Dia. horse-power cylinders, 14 inches; dia. low pressure cylinders, 27 inches; stroke, 16 inches; dia. governor wheels, 84 inches, face 17 inches; dia. balance wheels, 84 inches, face 29 inches; speed, 210 revolutions per minute; steam pipe connections, 6 inches; exhaust pipe connections, 9 inches. The belts are the Jewell, oak tanned, double railway dynamo type, 66 feet long and 26 inches wide.

The switchboard, which is placed on a gallery at one end of the engine room, is of the General Electric type, and consists of eight machine panels, form K, and sixteen feeder panels, form C. Each feeder panel is equipped for two feeders.

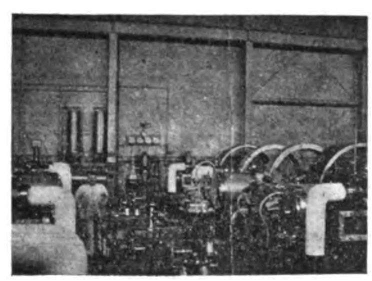
The condenser pit is situated beneath the center of the engine room, and is 19 feet below the floor of the latter. In it are placed four condensers and the receiver of the Holly gravity return system. All the steam mains are beneath the engine room floor, and are carried on concrete piers.



BALL & WOOD ENGINE.



ENGINE ROOM, SHOWING SWITCHBOARD.



ENGINE ROOM, SHOWING OILING SYSTEM.

BOILER ROOM.

The boiler room equipment consists of eight 300 horse-power Heine safety water tube boilers, two Worthington duplex 10 in. x 6 in. x 10 in. feed pumps, two No. 12 Monitor injectors, two No. 19 American feed water heaters, and two Spencer damper regulators.

The boilers are arranged in two batteries, facing each other, with the steam mains and connections supported on an iron structure directly over the space between the batteries. The steam mains are so arranged that each battery of boilers is entirely separate from the other. All the feed water pipes are brass, with cast iron fittings.

The principal dimensions of each boiler are: two shells, 36 inches dia., 19 ft. 3 in. long; 171 lap welded, 3½-inch tubes, 16 feet long; grate surface, 9 ft. x 6 ft., with 50 per cent. air space; 130 lbs. working pressure. The smoke flues are 88 inches in diameter where they enter the stack. The stack, which is self-supported, was made and erected by The Coatesville Boiler Works Company. It is 191 feet high and is made of ⅝-in., ½-in., ⅜-in. and ¼-in. steel plates, lined to the top with brick, with an inside diameter of 10 feet. The stack and lining weigh 350 tons. The Portland brown stone foundation, which was built by D. F. Keenan, weighs 1,500 tons.

The fire department apparatus consists of a Worthington Underwriters 16 in. x 9 in. x 12 in. duplex pump of 750 gallons per minute. The power house is heated by the Evans Hot Water System, which consists of the necessary coils and radiators, a 60 horse-power pipe heater and a small Worthington circulating pump.

OILING SYSTEM.

The lubrication of the machinery in the engine room is accomplished by an automatic gravity oiling apparatus designed and patented by the chief engineer, Mr. Frank Caum, and consists of a distributing and mixing device in the engine room and a filter and storage tanks in a separate building. The mixing device consists of two 60 gal. tanks and a combination of pipes and valves, by means of which either new or filtered oil or the two mixed can be fed to any engine. The supply of oil from the storage tanks to the engine room is controlled by a valve in the oil house, but which is operated from the engine room. Means are provided by which all the oil in the engine room can be forced to the oil house or out doors in case of fire. The filter and storage tanks are placed in an oil house, which is a brick building located in the rear of the boiler room. All oil is handled by means of compressed air.

Water from the Connecticut River is used in the boilers and for condensing purposes. The fuel used is George's Creek Cumberland coal, and is received in barges via Connecticut River.

A recording wattmeter registers the work done by the station. The daily output at present averages 11,100,000 watt hours. The average amount of coal consumed per day is 50,000 pounds.

ACCUMULATORS FOR ELECTRIC CARS.

The directors of the Hanover (Germany) tramway system have published an important report, in which they narrate their experiences with accumulators as the source of the power for their cars. In Hanover both overhead wires and accumulators have been used for a considerable time, so that the managers are in a position to institute a reliable com-

parison. Taking everything into account, they pronounce in favor of the storage cell. The cost of maintenance they say has been determined with the utmost exactitude possible for the year 1896, and the managers reach the conclusion that the additional cost of accumulators does not exceed 1 groschen, or 0.2c. per mile. Consequently, it has been decided that the entire system shall, as soon as the requisite arrangements can be made, be driven by secondary batteries.

THE SPRAGUE MULTIPLE UNIT TRACTION SYSTEM.

In our last issue we gave a very full account of the experiments made by Mr. Sprague at Schenectady on cars of the South Side Elevated Railroad, of Chicago, equipped on his system of multiple unit operation and control. With this system, it will be recalled, each car is equipped with its own motors and any number of cars can be coupled together to form a train, which can be completely controlled from the platform of any car constituting the train. Automatic devices are employed which make it impossible for the motorman to waste current at starting, or to lose control of the train.

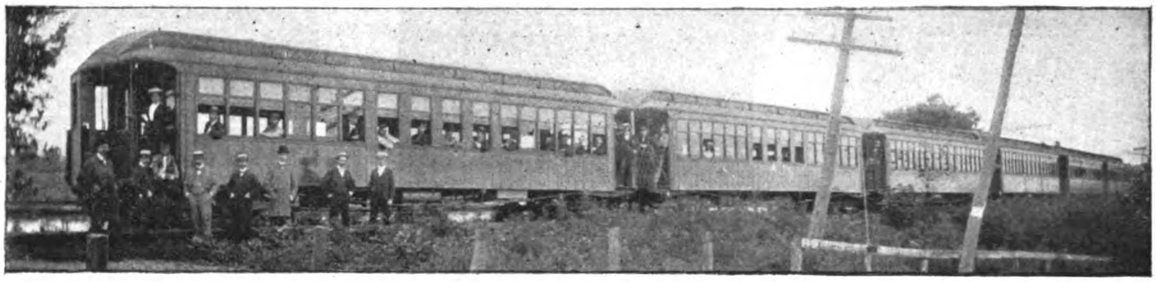


Fig. 1.—Train of Six Cars at Schenectady, Controlled by Sprague Unit Multiple System.

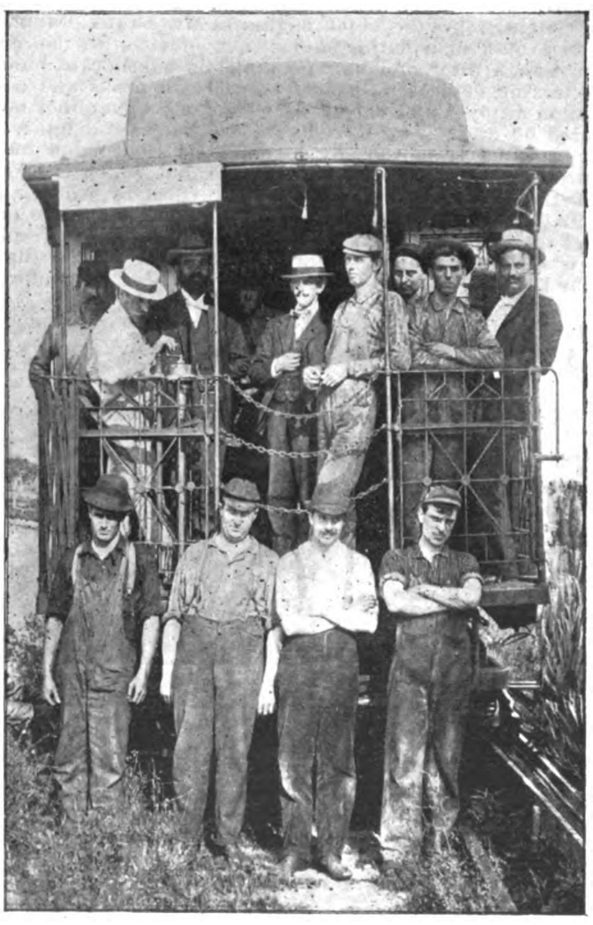


Fig. 2.—End of Car, Showing Suspension of Control Mechanism and Position of Levers.

The accompanying engraving, Fig. 1, shows a view of the six-car train used in the tests at Schenectady, Fig. 2 showing the end of a car with the automatic regulating devices hung from the canopy of the car platform. The controller and air-brake handles are shown at the left next to the platform rail.

ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.—I.

BY PROF. S. H. SHORT.

The elevated railways of New York, Brooklyn and Chicago were built to satisfy a crying demand for rapid transit from the business centers to the suburban districts of these great cities. So long as they had for their only competitor the slow moving horse car, they were considered a great convenience, notwithstanding that one was obliged to walk from one to three blocks and climb a difficult flight of stairs to reach these rapidly moving trains.

Since the "trolley car" has come into general use, people have been educated to a still more rapid rate of travel, and where the trolley car parallels the elevated railroad, as in Brooklyn and Chicago, the frequent, speedy and accessible surface car is, by far, the more popular. In New York, however, the elevated railways still enjoy a very large traffic, be-

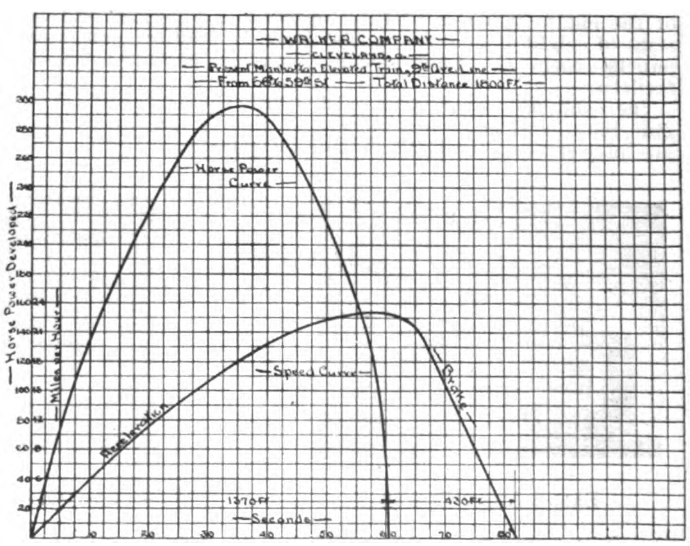


Fig. 1.

cause the electric cars do not parallel their lines, nor are the facilities for transportation yet sufficient for the enormous masses to be moved back and forth in that city. However, the surface lines are soon to be equipped electrically, and their carrying capacity thereby enormously increased to the detriment of the elevated railway travel. In order to retain their traffic, it will be necessary for the elevated railways to move their trains more frequently, and at a much greater rate of speed, to compensate the traveling public for being obliged to walk some distance and climb those disagreeable stairs.

It would add greatly to the travel on these roads, were some plan devised for mechanically lifting passengers to the elevated stations.

The elevated roads are all built on the same general plan, the structure being provided with double track throughout the entire length, with stations about one-third of a mile apart. The grades are slight, and the curves of not less than 90 feet radius. The structure is made to safely carry the standard elevated train, i. e., five passenger coaches, each 48 feet in length, weighing, when loaded with seventy-five passengers, 20 tons, drawn by a locomotive weighing 23½ tons, making a total of 123½ tons for the complete train.

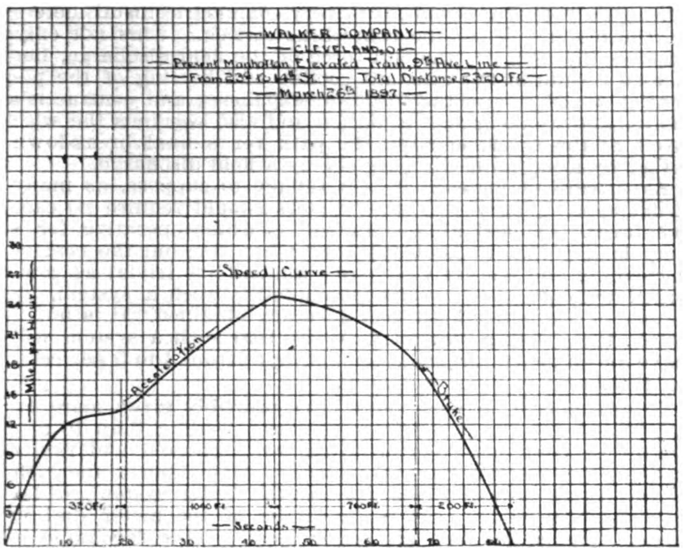


FIG. 2.

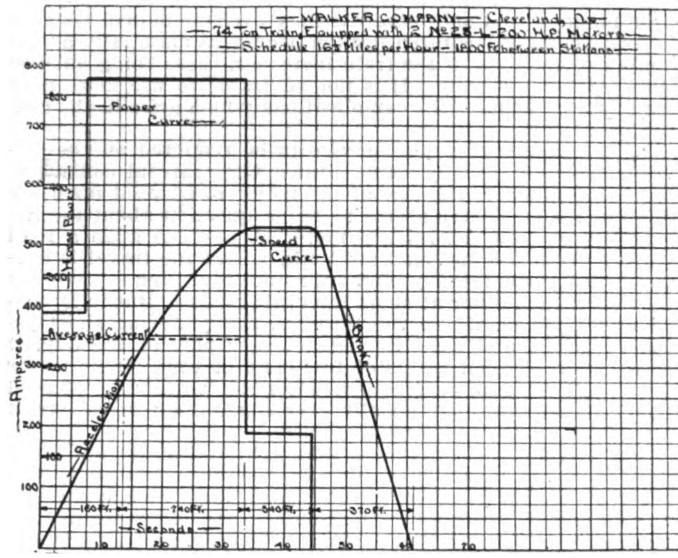


FIG. 4.

The locomotives are constructed so that 65 per cent. of their weight, or 15¼ tons, are upon their drivers, giving an adhesion, and therefore a maximum horizontal effort for accelerating the train, of 7,650 lbs. This effort is utilized for accelerating the train for 50 or 60 seconds, and a speed of 20 to 25 miles per hour is attained, while a maximum of 300 h. p. is developed by the locomotive. The brakes are then applied with a negative acceleration and the train is brought to a standstill at the next station, where it remains on an average of thirteen seconds.

In the accompanying diagrams (Figs. 1 and 2) I have illustrated graphically the performance of one of these trains between stations, also the consumption of power, as calculated from the weight and speed of the train. It will be seen therefrom that it is not possible, with steam, to make a better schedule time than is at present in force, i. e., 13½ miles per hour, unless the weight of the locomotive be increased or the trains be lightened. The heavier locomotives would endanger the safety of the entire structure. The lighter loads would necessitate more frequent trains, consequently a much larger force of skilled employés to run the extra locomotives. The cost of fuel for operating a steam locomotive amounts to about 20 per cent. of the total operating expenses of these roads, the fuel consumption being about 7 lbs. to 8 lbs. of coal per horse-power per hour.

With good compound condensing engines, driving electric generators at a station, the coal consumption is reduced to about one-third of that amount.

Were steam locomotives discarded, it would be possible to replace the high-price skilled labor, necessary for their operation, by ordinary trustworthy men, who are not skilled mechanics; whose rate of wages is about one-half that of a locomotive engineer, and only one man would be necessary to operate the electrical propelling mechanism. We believe the repair account will be materially lessened, both in the units of motive power and in the permanent way, were the trains equipped with motors. The care of a steam locomotive is very onerous, the average run being only about 100 miles, when it must be thoroughly overhauled and inspected by skilled mechanics before being used again. Contrast with this the all day service of most electric motors, 200 or 300 miles a day for days and weeks, without inspection, cleaning or care of any kind.

The standard electrical equipment for an elevated train consists of the present elevated car, as illustrated in the accompanying diagram (Fig. 3) provided with two swiveled trucks of special construction, arranged to receive electric motors of a type adapted especially for this service. The wheels of the trucks are 33 inches in diameter, and the wheel base does not exceed 6 feet for the largest motors, and is reduced to 5 feet 6 inches, where motors of the smaller size are used. The weight of the motor car, loaded to its full capacity with passengers, is 32 tons, including trucks, motors and the electrical equipment. In most cases it is advisable to use only two motors upon a motor car, and both should be placed on one truck for convenience in repairing. There is, therefore, 19½ tons upon the drivers, or 61 per cent. of the total weight of the motor car, which corresponds favorably with the percentage

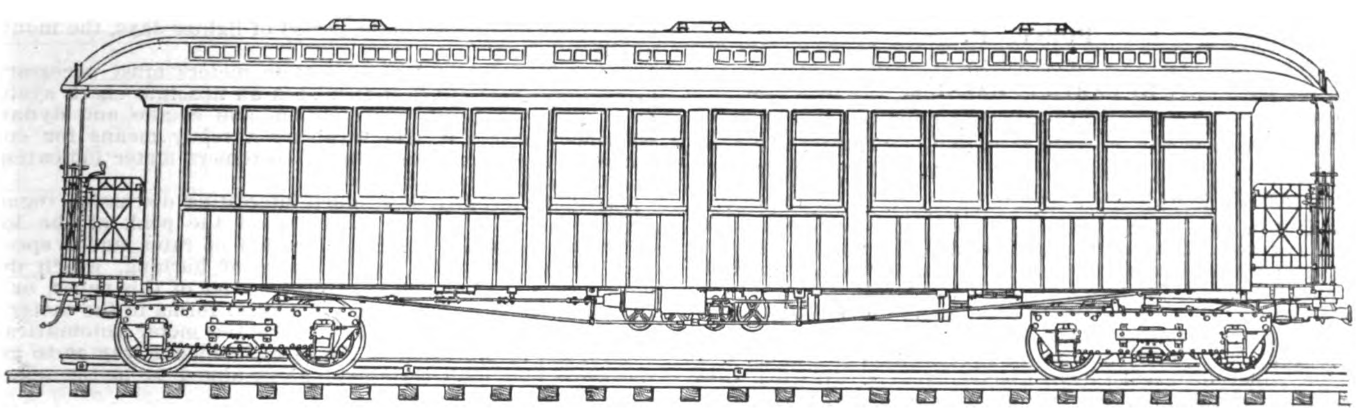


FIG. 3.

of the total weight of passenger locomotives upon their drivers. This gives an adhesion, and therefore a maximum practical horizontal effort, for the motor of 9,750 lbs., or, a total horse-power of 400, in accordance with standard motor rating.

This pair of motors is, therefore, capable of accelerating a train of three standard elevated cars, at the rate of 1.85 feet per second, and of making a schedule of 16½ miles per hour, including stops, as illustrated graphically by the accompanying diagram (Fig. 4).

If the other truck of the motor car is also equipped with motors, a train of double this size will operate in exactly the same manner, and one more car may even be added, because the tractive effort required per ton decreases materially as the number of the cars in the train increases, there being but one motor car on the train. It is not advisable to use more than two motors, owing to the complications which arise in the controlling devices.

The requirements of the service to be rendered on the different elevated railways necessitates very careful consideration being given to the size of the motor to be used upon the different roads. There seems to be no question about the advisability of using as large a motor as possible upon a road like the Sixth Avenue, in New York, where the travel is constant throughout the day, and trains of from four to five cars can follow each other at short intervals all day. But in Brooklyn and Chicago, where the traffic is heavy during short periods of time, and light during a larger part of the day, it seems desirable that trains of few cars, or even single motor cars, shall be run at frequent intervals without a printed time table; thereby practically securing a high speed street car service on the elevated structure.

Another reason for frequent and light trains, is that these roads have branches, which, by this method, would be served to better advantage. It is possible, also, that these single motor cars or short trains may be coupled into longer trains during the rush periods of the day, and be operated from the front platform by one motorman, if a suitable controlling apparatus is provided, by means of which all of the motors of the train can be simultaneously controlled.

A motor of much smaller size than would take up the full adhesive power of the truck could be used, where this method of equipment is adopted. It has, however the disadvantage of multiplying the electrical apparatus necessary to move the rolling stock of the road. It will also consume more power per ton-miles of train, because the tractive effort per ton of the trail cars is about half that required by the motor cars, the difference being due to the friction, windage, etc., of the motor cars.

MISCELLANEOUS

ELECTRIC METERING FROM THE STATION STANDPOINT.—II.

(Concluded.)

BY CARYL D. HASKINS.

THE methods which are commonly practiced in tampering with meters can scarcely form any proper part of a technical paper; but as this paper may go into the hands of some who need the knowledge to guard themselves and their interests, it can do no harm to briefly state the common methods used, not only that they may be guarded against, but also that meters may be selected which lend themselves least readily to such practices. It is not unusual to place large masses of iron above, below or at the side of meters, but this practice is falling somewhat into disrepute among its advocates, since even they have in time discovered that there is a class of meter which it accelerates. Electromagnets, drawing their energy from the circuits under measurement and used as the iron was formerly used, are now not uncommon, and it is difficult to prove in court deliberate evil intent. Meter covers and bases are drilled and wires, broom straws and the like inserted. Covers are pried up and healthy colonies of spiders introduced. Ingenious individuals have even been reported as finding profit in a clever apparatus for injecting fine iron filings into meters by means of a bellows.

The most radical cause of trouble in connection with installation is vibration and the consequent reciprocating motion of the shaft; for this reason the most solid of foundations should be selected, the neighborhood of moving machinery should be avoided, as should also partitions of light construction in which doors are located. The rhythmic vibration of moving machinery is infinitely more dangerous than occasional heavy shocks. Meters should be installed as near to the foundation as possible, not as is now quite common, at the top of buildings, where the amplitude of all vibrations is of course much greater. Locations where great variations of temperature occur are undesirable. For this reason, also, basements are preferable to attics.

A very common error, causing the loss of very many meters annually, by the burning out of the potential circuits, occurs in connection with the metering of power delivered to motors. In the effort to save the very trivial amount of energy passing through a potential circuit, it is very common to instal meters on the motor side of the controlling switch. This not only exposes the meter to the full force of the field discharge, but it also results in the constant cooling and heating of the potential winding, and the resultant expansion and contraction chafes and weakens the insulation and also weakens the wire itself at the turns, opening the path for a final breakdown either by a lightning discharge or by a field discharge.

As to care of meters. It is a fallacy to suppose, as many insist upon doing to-day, that meters should require no care whatever. Almost all meters will continue operative for a very long period without any care whatever; but the cost of a cleaning and testing visit twice annually is trivial as compared with the good results which follow such a system, by reason of the better light load accuracy obtained. It is not, I think, too strong a statement to say that such a system will have an influence for good, amounting to from 3 to 5 per cent. on the meter readings annually.

Central station managements have probably given more attention to systematic methods of meter reading than to any other one point contributing to success. The old and faulty plan of reading the dials of a meter at the time of the visit to the meter, is fast giving place to the better system, which provides the reader with a fac-simile of the meter dial in blank upon a page of his meter book. This fac-simile is roughly marked in pencil to indicate the position of the hand at the time of the visit. These fac-similes are taken into the office and are all read by one individual who is an expert in meter reading, and who sets down the consumption under the fac-simile on each page. Such a system commonly reduces the errors from about 10 per cent. per month where they not uncommonly stood under the old system, to materially less than 1 per cent. under the new; for, surprising as it may seem, it is an extremely easy thing to make mistakes in reading meter dials.

In changing from the old and not infrequently popular contract system, a good many central stations in the earlier days made the grave blunder of going on to the new basis during the winter months, with the result that the highest bills of the year reached the customer after a long period of indulgence under the contract system, and the result at times proved temporarily disastrous.

I have lately been much impressed by a system which was recently adopted by a prominent Western company to at least partially offset this difficulty. During the months which are growing darker, they read their meters a day or two earlier each month, thus arbitrarily creating shorter months, while as the year progresses to the period of lighter days, the months are lengthened.

The value of a system of station meters must necessarily prove very great, since it furnishes an absolute check system upon coal and water consumption, and engine and dynamo efficiency. While it also furnishes a ready means for comparison between station output, customers meter indications, line losses, leaks and grounds.

There has recently been much interesting discussion regarding the question of the flattening of the peak of the load either by the systematic modification of rates under special time contracts, governing the hours of burning, which does not concern the immediate subject matter of this paper, or by an actual modification in one of several forms in the meter itself, which should practically make the meter automatically control the modification of the rates in such a way as to gain the same end with certainty, as is aimed at in the special contract system.

It is quite obvious that the best double rate meter will be that which tends to flatten the load curve of the station, not by oppressing or discouraging the user of light, who must have his light at the period of the peak, so much as by encouraging the use of light at other periods. We do not want to provide means for cutting off the peak so much as we want means for raising the rest of the curve to the same height as the peak. In my personal opinion, it is in this respect that perhaps the most ingenious of all these double rate meters falls short.

If two-rate meters are to be used, I believe that their increased proportional speed should be dependent purely upon the occurrence of the station peak, and should bear no rela-

tion whatever to the occurring of the local peak. Such an arrangement can be secured in a number of ways, all of them simple and all of them effective.

One other feature of metering, which has recently come into existence in Europe, is about to make its appearance commercially in this country. It brings with it much of promise for the increase of profitable business for central stations. I refer to the prepayment meter system, the drop-a-nickel-in-the-slot and get-your-money's-worth-meter. In gas practice this system has proved an unqualified success. I am informed that the London Gas Light Company added 6,000 new customers of a profitable kind over and above their average annual growth in a single year; and other companies have had similar experience.

There is in every large city a considerable area into which illuminating companies have been unable to go by reason of the untrustworthy character of the people who would there be their customers. In other words, because the people in these districts are a floating population without credit, coming to-day and going to-morrow, and yet ready and willing to buy electric light at high rates. The prepayment meter throws open this new field and makes it immediately available; and here I predict for it wide usefulness.

THE ALTERNATING CURRENT INDUCTION MOTOR.—II.

BY CHAS. PROTEUS STEINMETZ.

If besides high resistance the motor has high admittance also, as No. 3 in Fig. 5, the high efficiency maximum at light loads is cut off and the efficiency curve flattened and lowered. The power factor rises very slowly at light loads, reaching a lower maximum. Characteristic, however, remains the large drop in speed, while the exciting current has increased very greatly also.

The reverse, a high reactance motor, is motor No. 4, shown in Fig. 6. Characteristic of this motor is the constancy of speed, 3.3 per cent. drop at full load, and especially the efficiency curve, which rises slowly, but reaches a fairly high maximum at or rather above full load. Power factor and apparent efficiency are low, with maxima beyond full load, and rise very slowly; that is, are poor at light loads. As seen, such a motor is in general unsatisfactory and may be less objectionable only in special cases, where it is running constantly at or near high admittance by high exciting current and poor power factor and apparent efficiency at light loads.

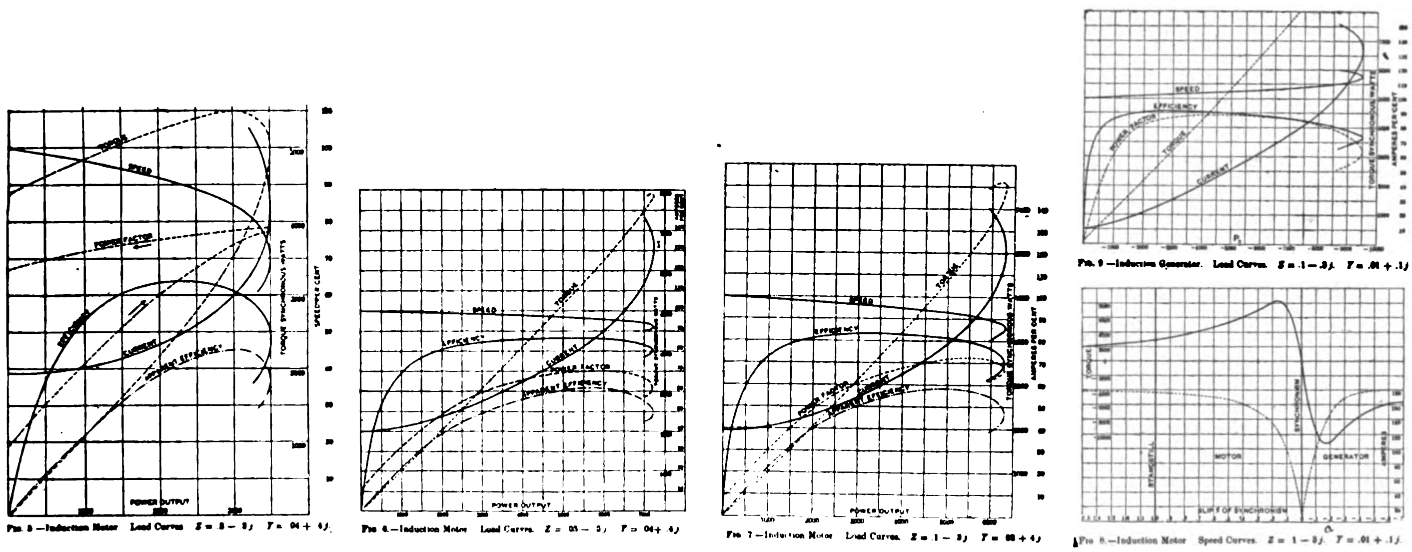
An abstract of the data of these motors and a number of other motors is given. (See table, page 85, of last issue.)

Speed Curves.—The load curves discussed in the preceding are especially characteristic of the action of the motor when doing work at its proper speed near synchronism. The action in starting, or in running at intermediate speeds, or beyond synchronism, or when driven backward, are best shown by what I may call the speed curves of the motor. A set of such curves, corresponding to the motor, No. 1 in Fig. 3, are shown in Fig. 8. These curves give with the speed; that is, the slip, as abscissæ, the torque in watts at synchronism and the current input of the motor. As seen, the torque is zero at synchronism, increases with increasing slip; that is, decreasing speed, reaches a maximum of 8,250 synchronous watts at 16.5 per cent. slip, and then decreases again, reaching 2,920 synchronous watts at $s = 1$; that is, standstill, and keeps on decreasing for $s < 1$; that is, backward rotation, without change of direction, thus representing consumption of energy by the motor. The negative or generator part of the torque curve is higher than the positive or motor part; that is, driven as generator above synchronism the machine consumes more mechanical torque than it produces running as motor below synchronism. Thus, the induction motor shares with the continuous current shunt motor the feature to be a motor only below a definite speed, but to become generator or act as brake by returning energy into the line, when driven above its speed.

The load curve of the motor corresponds to the part of the speed curve between synchronism and maximum torque at positive slip. From the part of the speed curve between synchronism and maximum torque at negative slip, or above synchronism, a corresponding load curve can be constructed of the machine as induction generator. This curve is shown in Fig. 9. As seen, it is very similar to the motor load curve, except that the speed curve bends upward.

To derive a certain value of current from the induction generator, the total load put on it must have the particular power factor corresponding to this current, and besides leading current, or if the power factor of the load changes, current and voltage of the induction generator will change accordingly. In consequence thereof, in general the induction generator is stable only, if at least a part of the load consists of synchronous motors.

The current in the induction machine is a minimum at syn-



FIGS. 5, 6, 7, 8 AND 9.

full load, or where very close speed regulation is required and wattless currents less objected to.

No. 5, in Fig. 7, shows a high susceptance motor. This motor is characterized by good efficiency at light loads as well as heavy loads, but power factor and apparent efficiency are very low at light loads and rise very slowly and reach their maximum only at or above full loads.

Comparing the different motors with each other, we see that a good motor is characterized by high values of power factor, efficiency and apparent efficiency at light loads, as well as heavy loads, by fairly close speed regulation and low exciting current.

High resistance is characterized by poor speed regulation and lowering of the efficiency at heavy loads, high reactance by very good speed regulation, good efficiency at heavy loads and low power factor and apparent efficiency at light loads, chronism and decreases on either side of synchronism, first very rapidly and then slower, and becomes fairly constant afterward, as seen in Fig. 8. In the particular motor under discussion, the whole variation of current is practically comprised within the range from $s = + 4$ to $s = - .3$, s being the slip. That is, the current at standstill is very large and remains practically constant until about ⅔ of synchronous speed is reached. Thus, such a motor with low armature resistance will require a very large current, not only in starting, but also at intermediate speeds.

As seen from the preceding, the motor No. 1, while very satisfactory at speed, requires excessive current and gives little torque at low speed and in starting, and is thus unsatisfactory therein.

An increase of armature resistance, r_1 produces a proportional increase of slip, n, and thereby corresponding decrease

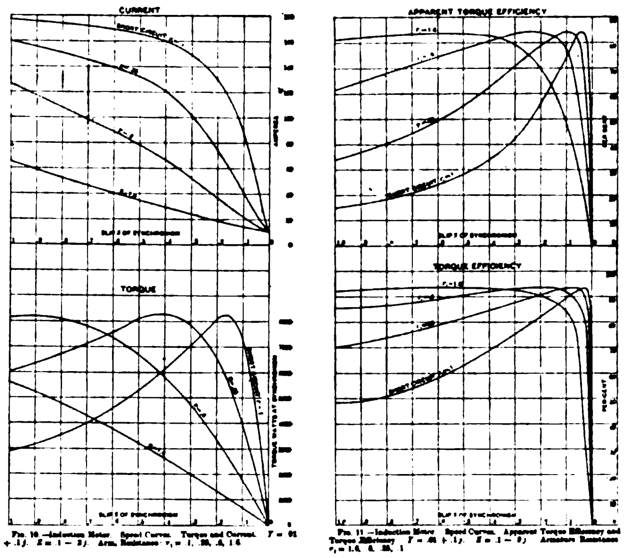
of power, efficiency and apparent efficiency, but does not change the torque, current and power factor.

The insertion of resistance in the armature or secondary of the induction motor offers a means to reduce the speed corresponding to a given torque, and thereby any desired torque can be produced at any speed below that corresponding to armature short circuit, without changing torque or current. Hence, given the speed torque curve of a short-circuited motor, the torque curve with resistance inserted in the armature can be derived therefrom directly by increasing the slip in proportion to the increased resistance.

This is done in Fig. 10, in which are shown the speed curves of the motor No. 1 between standstill and synchronism.

On the same diagram, Fig. 10, are shown the currents corresponding to the different values of secondary resistance.

The apparent torque efficiencies of the motor under the four



FIGS. 10 AND 11.

conditions of armature resistance are given in Fig. 11. They show that, although a considerable starting torque can be reached by a moderate armature resistance, of $r_1 = .25$, the apparent torque efficiency or torque per ampere input is still very low under this condition; that is, the motor starts very inefficiently, and, as seen in the preceeding discussion of high resistance motors, is rather inefficient at speed. The same diagram also shows the torque efficiencies. It follows herefrom that permanent resistance in the armature of an induction motor can be used to secure good starting torque at the sacrifice of current in starting, and of efficiency and speed regulation when running, but cannot be used to limit the starting current, the latter requiring so large an armature resistance as to make the motor entirely unfit when running.

CARBORUNDUM ABROAD.

A NEW carborundum plant has been established in Dresden, Germany, as a result of the visit of Mr. E. G. Acheson, president of the Carborundum Company of Niagara Falls, to that place. Mr. Acheson has returned from his European tour, and reports good success. He states that a local company will operate the Dresden plant of 400 h. p., and that it will be run by current obtained from the municipal lighting plant of Dresden, which is operated by steam, but, despite this, Mr. Acheson looks for good returns from the German plant. The new factory will supply the German trade with carborundum in bulk, and will not manufacture it into wheels, etc., but the manufactured carborundum will be supplied from the Niagara Falls plant.

While in England Mr. Acheson established an English agency for the sale of carborundum in London, and prospects are that very soon they will receive very large orders from there, which will be filled from Niagara Falls. The Niagara Falls factory is very busy now, and the additional trade of which the company is assured will add to the activity of the plant.

The carborundum furnaces in use at Niagara Falls to-day are about 6 feet wide and 16 feet long. They are burned 36 hours instead of 24, as at the start. The average product is about 4,200 lbs. a day, and the product of the company finds a very ready market. Mr. Acheson's success while in Europe is exceedingly gratifying to those interested in business with him at the Falls, and his return was hailed with pleasure. Mr. Acheson makes his home in Buffalo, but both he and the other officials of the Carborundum Company are held in high esteem by the business men of Niagara Falls, where they transact business daily.

MECHANICAL

COAL PRODUCTION IN THE UNITED STATES.

THE compilation of the statistics of coal production in the United States in 1896, which has just been completed by Statistician E. W. Parker, of the United States Geological Survey, shows that the product in 1896 was 190,639,959 short tons, valued at $195,557,649, against 193,117,530 short tons, valued at $197,799,043 in 1895, a decrease of 2,477,571 short tons in amount and of $2,241,394 in value. The decrease in product was entirely in that of Pennsylvania anthracite. The output of bituminous coal shows an increase of about one and three-quarters million tons. The anthracite product of Pennsylvania decreased nearly four and a quarter million tons. It is a notable feature, however, that there was a decrease in the value of the bituminous product of over $1,600,000 notwithstanding the increased output and that there was a comparative increase in the value of anthracite, although, on account of the smaller production, it did not equal the value in 1895. The average price obtained for anthracite at the mines increased from $1.41 in 1895 to $1.51 in 1896. The average price for bituminous declined from 86 cents to 83 cents.

Among the important bituminous coal producing States, Pennsylvania, of course, stands first, with an output of nearly 50,000,000 tons. Illinois is an easy second with nearly 20,000,000 tons, or more than 75 per cent. of the combined product of West Virginia and Ohio, which come third and fourth, respectively. The race between Ohio and West Virginia was very close in 1896, there being but a thousand tons difference, and the output of each nearly 13,000,000 tons. These four States yield about 70 per cent. of the total bituminous production.

Pennsylvania's bituminous product was a little more than a million tons less than in 1895. Ohio lost 480,000 tons. West Virginia increased her output about 1,500,000 tons, and Illinois about 2,000,000 tons. The other important States showing increased production were Alabama, Arkansas, Colorado, Indian Territory, Kentucky, Maryland, and Texas; while Indiana, Iowa, Kansas, Missouri, Montana, New Mexico, Tennessee, Utah, Virginia, Washington and Wyoming showed decreased production. West Virginia had the most important increase among the Appalachian States, Illinois in the Middle West, and Colorado was the only State in the Rocky Mountain region whose production increased.

COST OF STEAM POWER IN NEW ENGLAND MILLS.

IN our issue of July 22 we published the figures of cost of steam power in New England mills, as arrived at by Mr. F. P. Sheldon, consulting engineer for the West End Railway Company, Boston. In commenting editorially on the results arrived at by Mr. Sheldon we expressed doubts as to the correctness of the low figures arrived at, and in reply to a private communication we have received the following from Mr. Sheldon:

My figures were not in any sense "results arrived at by me" in some mysterious manner, but simply taken from accounts whose integrity I have no reason to question, and which were not made up with any anticipation of ever being shown, and we do not consider them so amazing as you seem to. On the other hand, we should consider amazing a compound steam engine plant of 1,000 h. p., which would cost for fuel $10.69 per year with coal at $3 a ton for power alone for 3,080 hours. I have accounts from another mill where coal is $4.10 per ton, and the cost per horse-power per year for fuel is $9.10, and I believe tthe accounts are faithfully kept, as I am personally acquainted with the men who keep them.

Here is another case which may interest you: A mill in

New England, with coal at $3.84, and all the fuel for heating the buildings in our winters (with over 150,000 square feet of floor space in them), besides steam for sizing yarn, cost per horse-power per year for fuel $9.69; and total cost in this mill, including labor, supplies, repairs and fixed charges (same as given in my other figures) $17.89 per horse-power per year of 3,080 hours. This with coal at $3.84, and including heating, which is no small item in this climate.

You can see that if coal at this mill were $3 a ton, the cost of fuel would be reduced to $7.57 per horse-power per year, including heating, etc., and the total cost, to $15.77 per horse-power per year (3,080 hours in this case and a 1,200 h. p. plant).

Finally, none of these cases are in any respect an exceptional steam plant. And I should say that a modern compound engine plant of 1,000h. p. which, with coal at $3, costs $25.53 per year per horse-power, is sadly in need of overhauling. It is evident a good many people are not posted on what is being done in our textile mills, and without any great cry over it, either.

LEGAL NOTES

ELECTRIC HEATING LITIGATION.

WE would be glad to have you print the following in the next issue of The Electrical Engineer. The following states definitely the result of the recent decision in our favor by the United States Circuit Court of Appeals:

"The United States Circuit Court of Appeals for the Second Circuit, on Thursday, July 22, rendered an elaborate and sweeping decision, reversing the decree of the Circuit Court, which had granted to the Dewey Electric Heating Company an injunction against the Albany Railway Company, to prevent the use of the Consolidated Car Heating Company's temperature regulating switch in connection with an indicating device, as being an infringement of the ninth claim of the Dewey patent, No. 464,247. The court holds that this claim is entirely void for want of patentable invention, and this decision finally settles the right of the Consolidated Car Heating Company and its customers to use its temperature regulating switches with indicators as the same have been and are now constructed."

CONSOLIDATED CAR HEATING CO.,
FREDK. W. KELLEY, Assistant Treasurer.

THE CARBORUNDUM PATENTS SUSTAINED.

On Tuesday, July 27, Judge Buffington, in the United States District Court for the Western District of Pennsylvania, rendered a decision in the case of the Cowles Electric Smelting and Aluminum Company, of Lockport, vs. the Carborundum Company, of Niagara Falls. The decision was in favor of the Carborundum Company. The carborundum patents were obtained by Mr. E. G. Acheson, who is president of the Carborundum Company.

This case became celebrated not only in the United States, but in Europe, and had the decision been given in favor of the Cowles Company, it would have given them practical control of all metallurgical operations in which electric furnaces are used, as the Cowles Company claimed the original rights on all furnaces. The suit was first entered in 1894, and the argument before Justice Buffington was begun on December 7, 1896. Over 1,400 pages of expert testimony were taken in the case. It was the claim of Alfred H. Cowles that the electric furnace used was his discovery and that he had made carborundum in 1885. However, he did not himself know this until 1894, when specimens of carborundum were produced from the Boston museum. The suit asked for an injunction restraining the Carborundum Company from using the furnace.

The case of the defense was based on non-interference. In presenting the case to the court from which the decision has just been obtained, the defense was represented by George H. Christy and Thomas and Wm. Bakewell, while E. N. Dickerson, of New York, and C. M. Vorce, of Cleveland, represented the plaintiff.

There was great rejoicing at Niagara Falls when the import of the decision became known. The Carborundum Company was among the first enterprises to locate on the lands of the Niagara Falls Power Company, and their business grew so rapidly that the factory was very early enlarged. The business of the Monongahela City, Pa., plant was transferred to the Falls, and to-day the furnaces produce on an average 4,200 lbs. of carborundum per day. The business has spread to such an extent that plants have been established in Austria and Germany. Canada will have a plant within a year in all likelihood, while the Niagara Falls plant supplies the English and other foreign markets. No industry at Niagara Falls has prospered more than the Carborundum Company, and had the decision been against the company the effect would have been far reaching.

TROLLEY AND STEAM CROSSINGS

At Columbus, Ohio, on July 24, Railroad Commissioner Kayler made a decision that means much to the railroad interests and will no doubt establish a precedent in crossing disputes between electric and steam railroads. He holds that an electric road wanting to cross an established steam road must provide the necessary protection for itself and not interfere with the running of trains of the steam road in any way.

OBITUARY

HON. GEORGE S. HALE, of Boston, who died suddenly last week at his Bar Harbor cottage, was the father of Mr. R. S. Hale, the well known electrical and steam engineer, for whom deep regrets are felt at this heavy and serious loss.

NEWS AND NOTES

TESLA ELECTRIFIES THE EARTH.

According to the New York "Journal," of August 4, Mr. Tesla announces the completion of his work for the transmission of messages from one point to another on the earth, without the aid of wires. To give an idea of the high potential currents used in this work, he showed a large disc, from the center of which protruded a spherical electrode shooting forth long streams of ethereal flame. Mr. Tesla stated that the electrical disturbance thus created was felt throughout the globe. The article is graphically illustrated with a large picture of the contrivance for emitting the discharge.

THE STOCK MARKET

THE RISING TIDE.

THERE can be no question about the fact that right now, in the deep dullness of midsummer, a turn for the better has been made. It is signalized in many ways, and not least of all in the very early fall demand for staple merchandise of all kinds, especially out West, where current prices and large quantities of agricultural product have already created a most cheerful atmosphere. In manufactures, the settlement of the tariff has done much to improve things, and the increase in consumption creates a condition that is decidedly favorable. The figures of increase in the output of Bell telephones tell a remarkable story of better times, for the gain is made in the face of a severe competition and, therefore, counts double.

The stock market is responding to all these upward tendencies. Last week, of Western Union, there were sold 25,304 shares up to 86½, and of General Electric 27,987 shares up to 36⅛. On sales of 360 shares, American Bell was up to 228.

As to General Electric deferred dividends, "Rialto" has the following in the Boston "Advertiser:" New York hears that negotiations are well advanced toward settling with General Electric preferred stockholders for their accumulated dividends. When this is accomplished, it is said to be the intention of the managers to reduce the capitalization about 50 per cent., and put the new stock on a 6 per cent. dividend basis. A 6 per cent. manufacturing stock, it is claimed, would not be worth much more than 70, therefore the present price of General Electric at 35 is thought to represent about 70 for the new stock.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 20, 1897.

Alarms and Signals:—

ELECTRICAL GAS ALARM. J. Erikson, Providence, R. I., 586,813. Filed April 3, 1897.
Employs the heat of the gas flame to keep an electric circuit open that would otherwise be closed and sound an alarm if the stop-cock is open sufficiently to allow the escape of any gas.
ELECTRICAL SIGNALING APPARATUS. A. A. Andersen, Altoona, Pa., 586,891. Filed February 14, 1896.
For use with an arbitrary code.

Batteries Secondary:—

ACTIVE MATERIAL FOR SECONDARY BATTERY PLATES. S. A. Rosenthal, London, England, 586,627. Filed October 15, 1896.
Composed of oxid of lead, a rubber binding material soluble in the usual acid exciting agent and sulfate of ammonium.
CONNECTION FOR ELECTRIC SWITCHES. H. A. Bullard, Pittsfield, Mass., 586,543. Filed May 5, 1897.
Comprises a tapered plug, screw threaded at its extremity adapted to correspond with a nut carried in a recess in a block, connection being made through an annular groove opposite the recess.
FLEXIBLE INSULATED CONDUCTOR. J. H. Kelman, Pittsfield, Mass., 586,554. Filed November 27, 1896.
Consists of an extended length of electric conductor and a coating thereon of oxidized oil varnish such as linseed oil varnish.
CONNECTOR FOR ELECTRICAL CONDUCTING WIRES. S. P. Hull and J. DuBois, Albany, N. Y., 586,665. Filed November 25, 1896.
Consists of a plate of conductive material, and binding screws arranged at the opposite ends, each having a flat circumferential flange at the inner end of its head, the connector being arranged to swing freely with any swaying movement of the wires.
ELECTRIC LINE INSULATOR. J. J. Tracy, Hartford, Conn., 586,700. Filed May 27, 1897.
Comprises an insulator having a base, a bracket connected with the base, at one end by a pivot and at the other end by a lug, and an insulating cap connected with the bracket.
ELECTRICAL CONDUCTOR. C. N. Dutton, New York, 586,811. Filed July 27, 1896.
A multiple-wired electrical conductor, having its wires woven around a forked support adapted for use as a trolley wire for canal boat service.

Dynamos and Motors:—

ELECTROMAGNETIC MOTOR. F. J. Patten, New York, 586,823. Filed December 4, 1896.
For description see page 50, Electrical Engineer, July 22, 1897.
ELECTRIC MOTOR. F. A. Perret, Brooklyn, N. Y., 586,825. Filed March 27, 1897.
Comprises a driving wheel and stationary axle, an armature directly connected with the wheel, a cummutator support mounted directly on the armature, a field magnet mounted directly upon the stationary axle, and a brush support mounted directly on the field-magnet.

Electro-Therapeutics:—

INDUCTION COIL FOR MEDICAL APPARATUS. H. C. Porter, Chicago, Ill., 586,622. Filed January 26, 1895.
Means whereby in one apparatus either a high tension or low tension current may be employed and regulated as desired.
COMBINED SYRINGE AND ELECTRICAL APPARATUS. L. G. Woolley, Grand Rapids, Mich., 586,679. Filed December 7, 1896.
An electrical apparatus having a normally open circuit adapted to be closed by a syringe acting as a weight and closing the circuit by the weight of the liquid in the bag, and permitting the circuit to open as the liquid escapes.

Measurement:-

ELECTRICAL METER. W. D. Marks, Philadelphia, Pa., 586,559. Filed January 23, 1897.
Combines with the actuating coils and the movable member means for eliminating or reducing magnetic lag.
ELECTRIC METER. W. D. Marks and G. R. Green, Philadelphia, Pa., 586,560. Filed May 20, 1897.
Comprises an oscillating motor, a brake carried by a stationary support and engaging periodically with a movable member of the motor.
EXCESSIVE CURRENT RECORDER. J. R. Cravath, Chicago, Ill., 586,723. Filed February 5, 1897.
Adapted for use on motor cars.

Miscellaneous:—

CIRCUIT CONTROLLER FOR ELECTRIC VEHICLES. K. Knudsen, Chicago, Ill., 586,606. Filed October 21, 1896.
ELECTRIC HEATER. J. F. McElroy, Albany, N. Y., 586,615. Filed August 14, 1895.
A supporting frame carrying at its upper and lower edges insulating blocks, a continuous coil arranged in zigzag fashion about the insulating blocks in such manner that the coils converge from top to bottom and vice-versa.
AMALGAM WASHING APPARATUS. H. C. F. Stormer, Christiania, Norway, 586,635. Filed February 6, 1897.
Consists in subjecting streams of amalgam in tubulous form to the action of a dissolving liquid.
PURIFYING WATER BY ALTERNATING ELECTRIC CURRENTS. E. Verstraete, St. Louis, Mo., 586,643. Filed June 16, 1896.
Comprises a settling basin adapted to contain liquid, electrodes therein, a source of alternating currents, a plurality of tension reducing devices, and switches in the working circuits whereby the tension of the current supplied to the electrodes may be changed.
ELECTRIC FURNACE. R. F. S. Heath, Camden, N. J., 586,686. Filed February 24, 1896.
A furnace for the manufacture of carbid of calcium, employing adjustable carbon electrodes and a revolving melting pot.
ELECTRIC FURNACE. R. F. S. Heath, Camden, N. J., 586,687. Filed February 21, 1896.
Employs electrodes adapted to be rotated around the melting chamber for the manufacture of carbid of calcium.
METHOD OF AND APPARATUS FOR EFFECTING ELECTROLYSIS. C. Kellner, Vienna, Austria-Hungary, 586,729. Filed February 24, 1896.
Consists in passing an electric current through a solution of a salt, to a mercury cathode flowing uninterruptedly from a higher to a lower level and before reaching the lower level flowing alternately and repeatedly out of contact with the salt solution into contact with an agent capable of decomposing the compound formed.
TROLLEY POLE. C. N. Dutton, New York, 586,809. Filed July 27, 1896.
Adapted for use on canal boats.
ELECTRIC FURNACE. F. J. Patten, New York, 586,822. Filed September 14, 1896.
Comprises a furnace wall, a pair of carbon electrodes inclosed within the wall, one of the electrodes being circular in cross-section, means for rotating the arc between and relatively to the electrodes and passage, arranged to convey material through the annular arcing space traversed by the rotating arc.
ELECTRIC FURNACE. F. J. Patten, New York, 586,824. Filed January 30, 1897.
Consists in passing an electric current through a mass of material of low and uniform conductivity, establishing around it a magnetic field, having its lines of force transverse to the line of current flow through the mass, and causing the field to rotate about the line of current flow.
ELECTRICALLY OPERATED VALVE. F. McDonald, Portland, Me., 856,861. Filed April 22, 1897.
Mechanism for controlling the flow of water through a fire hose.
ELECTRODEPOSITING DEVICE. J. Bossard, Dubuque, Iowa. 586,894. Filed May 31, 1895.
Consists of a tank, with anode connection, a circular carrier having cathode connections from which a number of articles to be deposited upon are suspended within the bath and are caused to rotate in a horizontal plane.
MAGNETO SPINDLE. A. Gartner, Paterson, N. J., 586,790. Filed May 3, 1897.
Comprises a base in which is mounted a sleeve-whirl spindle, driving means for operating spindle, and a magnet carried by the base and in close proximity with that portion of the sleeve-whirl which is in engagement with the driving means.

Railways and Appliances:—

TROLLEY GUARD. J. M. Kirker, Louisville, Ky., 586,556. Filed August 28, 1895.
Comprises an eccentrically mounted wire catching and restoring wheel positioned alongside of the trolley-wheel.
CONDUIT ELECTRIC RAILWAY. W. E. M. Jackson, Indianapolis, Ind., 586,602. Filed October 5, 1894.
Consists of an insulator comprising a non-conductive compressible open spiral, a containing cup, a cover and a standard on which the cup and cover are adjustable.
TROLLEY. W. Willett, Johnstown, Pa., 586,647. Filed March 22, 1897.
Employs two trolley wheels arranged at obtuse angles to the pole and adapted to embrace and ride upon the upper side of the trolley wire.
APPARATUS FOR WORKING ELECTRIC TRAMWAYS. C. Anderson, Leeds, England, 586,652. Filed February 13, 1896.
Employs a haulage cable for use as an auxiliary power actuated by an electric motor.
DASH ELECTRIC HEADLIGHT. J. Kirby, Jr., Dayton, Ohio, 586,774. Filed January 8, 1897.
An electric headlight having the open end of its case secured to the rear side of the dashboard, and means whereby the lamp may be adjusted to locate it in proper relation to the reflector.
ELECTROMAGNETIC THIRD RAIL SYSTEM. W. Grunow, Jr., Bridgeport, Conn., 586,845. Filed August 26, 1896.
An electrical contact system, consisting of a free reciprocating electromagnetic contact, operated by the alternate action of a separate electromagnet and gravitation.
UNDERGROUND SYSTEM FOR ELECTRIC RAILWAYS. A. S. Krotz, Springfield, Ohio, and W. P. Allen, Chicago, Ill., 586,852. Filed February 12, 1897.
Comprises a feeding conductor and a contacting rail, a support common to both, an insulator to which the support is attached, and a shield on the support and between the insulator and the contacting rail.
ELECTRIC RAILWAY SYSTEM. H. P. Wellman, Ashland, Ky., 586,920. Filed December 12, 1896.
A sectional conduit system employing a short circuiting switch comprising an electromagnet having its yoke removed, and means carried by the motor car for engaging the electromagnet and temporarily supplying the yoke.
ELECTRICALLY OPERATED RAILWAY BARRIER. C. C. Van der Vale, Haarlem, Netherlands, 586,578. Filed September 10, 1896.
Details of construction.
HEADLIGHT. C. Bash, Boston, Mass., 586,584. Filed November 9, 1895.
An electric headlight embodying an oil lamp for emergency use.
AIR CAR. A. Brodbeck, Chicago, Ill., 586,590. Filed August 26, 1896.
An aerial railway comprising an electric elevated rail, a balloon, a trolley carriage mounted on the rail, rods connecting the balloon and carriage, a car suspended from the balloon, electric propelling mechanism carried by the car, and an auxiliary electric rail and a pivoted trolley contacting with the auxiliary rail and carried by the trolley carriage.
ELECTRICALLY ACTUATED SWITCH MECHANISM. W. S. Browne, Brooklyn, N. Y., 586,702. Filed November 25, 1896.
An automatic switch for electric railways.

Switches, Cut-Outs, Etc.:—

FUSIBLE CUT-OUT. C. G. Perkins and J. Tregoning, Hartford, Conn., 586,565. Filed December 15, 1896.
Details of construction.
LIGHTNING ARRESTER FOR SWITCHBOARDS. A. M. Taylor, Niles, Mich., 586,575. Filed March 8, 1897.
Of the magnetic type. Details of construction.
RHEOSTAT. O. H. and A. F. Pieper, Rochester, N. Y., 586,864. Filed March 23, 1897.

Adapted for use in connection with a cataphoric apparatus used in dental operation.

ELECTRIC SWITCH. J. F. McElroy, Albany, N. Y., 586,933. Filed January 9, 1896.

The combination of an electric snap switch and an adjusting switch, whereby the adjusting switch is opened or closed by the snap switch.

Telegraphs:—

TELEGRAPH CABLE. J. M. Barr, London, England, 586,755. Filed December 26, 1896.

Comprises a pair of parallel adjacent conductors connected at one end to a common return, a source of current having one pole connected to the common return, contacts connected to the conductors at the transmitting end, and a key connected to the other pole of the source between the contacts.

Telephones:—

TELEPHONE ATTACHMENT. W. W. Beck, Sebastopol, Cal., 586,539. Filed March 5, 1897.

A holder adapted to support the telephone receiver in close proximity to the ear of the user.

TELEPHONE SWITCHBOARD. H. V. Hayes, Cambridge, Mass., 586,685. Filed January 29, 1897.

Means whereby all answered calls at the central station are recorded.

PENDENT MICROTELEPHONE. F. Muller, Berlin, Germany, 586,699. Filed December 12, 1896.

Details of construction.

TELEPHONE ATTACHMENT. S. C. Houghton, San Francisco, Cal., 586,793. Filed June 15, 1897.

A support for a telephone receiver movable laterally in two directions and having a swiveled section for supporting and reversing the receiver.

TELEPHONE SIGNALING RELAY AND CIRCUIT. A. S. Williams, Newton, Mass., 586,888. Filed May 20, 1897.

System of signaling the central station in which glow lamps are employed as line signals, one for each line, and in which a supplementary signal is associated with a series of such line lamps and made common to the series.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 27, 1897.

Alarms and Signals:—

ELECTRIC BELL. J. T. O'Brien, Bridgeport, Conn., 587,062. Filed April 13, 1897.

The ringing is accomplished by the opening and closing of a shunt circuit.

Conductors, Conduits and Insulators:—

CONDUIT. A. S. Krotz, Springfield, O.; W. P. Allen, Chicago, Ill., and O. S. Kelly, Springfield, O., 587,213. Filed May 28, 1896.

Provides an insulated shield for the conductor rail in "third-rail" system.

WIRE HOLDER. J. B. Lawrence, Salem, N. J., 587,216. Filed November 2, 1896.

Consists of an upright standard having feet provided with openings, upwardly projecting arms having interior screw threads, and an exteriorly-screw threaded insulator.

INSULATOR. H. Rudolf, Berlin, Germany, 587,273. Filed October 14, 1896.

Consists of a body portion having a head in which is formed a deep transverse groove in the bottom of which is a cavity adapted to receive a bend in the wire, the head being also provided with a transverse perforation which passes through the cavity, and a locking bolt which passes through the perforation, and holds the wire in place.

Dynamos and Motors:—

BRUSH HOLDER. N. M. Beede, Schenectady, N. Y., 586,957. Filed May 5, 1897.

Comprises an opening for the reception of a commutator brush, a brush movable in the opening, a flexible connection leading from the brush and a spring clamp secured to the flexible connection, and making an electrical connection, with the body of the brush holder.

FORM FOR WINDING COILS FOR DYNAMO ELECTRIC MACHINES. H. Geisenhoner, Schenectady, N. Y., 586,995. Filed March 16, 1897.

Means for giving the coil a shape while winding that is substantially the same as that of the finished article.

MULTIPOLAR DYNAMO ELECTRIC MACHINE. S. W. Rushmore, Brooklyn, N. Y., 587,163. Filed February 23, 1897.

For description see page 36, July 15, 1897.

DYNAMO ELECTRIC MACHINE. S. W. Rushmore, Brooklyn, N. Y., 587,164. Filed May 14, 1897.

For description see page 36, July 15, 1897.

Lamps and Appurtenances:—

ELECTRIC ARC LIGHT REFLECTOR. Chas. M. Bolles, Dallas, Tex., 586,986. Filed July 13, 1896.

Details of construction.

ADJUSTABLE LIGHT. F. A. Lavercomte, St. Louis, Mo., 587,151. Filed March 8, 1897.

Comprises an adjustable support capable of lateral movement upon a vertical support.

Measurements:—

RECORDING SPEED INDICATOR. Edward P. Decker, Brooklyn, N. Y., 586,961. Filed April 7, 1897.

The indicator mechanism is driven by an electric motor.

ELECTRIC METER. G. F. Packard, Fort Wayne, Ind., 587,015. Filed May 6, 1897.

Details of construction.

Miscellaneous:—

ELECTRICALLY OPERATED LOCKING DEVICE FOR ELEVATORS. T. W. Jenkins, Philadelphia, Pa., 587,002. Filed October 2, 1895.

Comprises a car with a power-controlling device and a door, a lock for the wheel, a magnet in an electric circuit controlling the lock and contact points connected by the action of the door.

ELECTRIC CONDENSER. C. S. Bradley, Avon, N. Y., 587,114. Filed October 7, 1895.

A condenser having its pile of plates inclosed in a fluid and air-tight metallic casing hermetically sealed at all points.

PROCESS OF AND APPARATUS FOR MANUFACTURING METALLIC CARBIDS. I. L. Roberts, Niagara Falls, N. Y., 587,138. Filed December 29, 1896.

Employs a continuous horizontal mechanical conveyor, two electrodes located in proximity thereto, and means for feeding a mass of material to be treated into the conveyor above and below the electrodes.

ELECTRIC PROGRAM-CLOCK. Ernest Bobsien and S. L. Prager, Mt. Vernon, N. Y., 587,143. Filed February 8, 1897.

Details of construction.

ELECTRIC FURNACE. G. De Chalmot, Leaksville, N. C., 587,182. Filed February 27, 1896.

Comprises a carbon pencil, a crucible into which the pencil may enter, and independent mechanism for agitating the crucible in order to shake down the granular material fed into it.

APPARATUS FOR TREATING DISEASES. H. Sanche, New Orleans, La., 587,237. Filed October 27, 1887.

An electric treatment involving difference of temperature in the positive and negative element.

Railways and Appliances:—

TROLLEY WHEEL FORK. S. B. Thompson, Baltimore, Md., 587,047. Filed December 2, 1896.

One of the supports of the trolley axle is formed of a flat spring the upper end of which presses against the hub of the trolley-wheel forming an electrical contact, and its lower end is rigidly secured to the base of the fork.

CAR STEP. Albert Blum, Cincinnati, Ohio, 587,073. Filed August 3, 1896.

Consists of a movable step operated by an electro-magnet.

RAIL BOND. J. A. Mosher, Chicago, Ill., 587,134. Filed June 21, 1897.

Comprises a flexible body portion provided with solid ends having riveting studs adapted to pass through the web of a rail.

TROLLEY. A. S. Krotz, Springfield, O.; W. P. Allen, Chicago, Ill., and O. S. Kelly, Springfield, O., 587,214. Filed June 16, 1896.

Consists of a base, one or more flat spring supports, a contact shoe attached to the free end of the spring supports, a conductor strip of high conductivity connecting the contact shoe and base, and a stop.

Regulation:—

RECTIFIER. E. Thomson, Swampscott, Mass., 586,024. Filed October 31, 1896.

Means for rectifying alternating current, which consists in passing the current through a rectifying device and by external power imparting to the rectifier a tendency to rotate at a speed greater than synchronism.

Switches, Cut-Outs, Etc.

LAMP SOCKET. H. C. Wirt, Schenectady, N. Y., 587,027. Filed April 30, 1897.

A two-part shell, one part of which is provided with L-shaped open slots, and the other with screws projecting through the L-shaped slots; in combination with a molded base having enlarged recesses into which the ends of the screws project and have play to lock the parts together.

FUSE HOLDER AND ELECTRIC CUT-OUT. H. A. Lewis, Norristown, Pa., 587,217. Filed January 11, 1897.

Is provided with a circuit breaker interposed in the line-wire, and a thermostat comprising a tube fixed at one end, and a line wire passing through the tube to heat the same, and intermediate mechanism for connecting the tube with the circuit-breaker.

CIRCUIT CLOSER. S. C. Houghton, San Francisco, Cal., 587,260. Filed May 14, 1897.

Details of construction.

Telegraphs:—

TELAUTOGRAPH. L. O. McPherson, Highland Park, Ill., 587,013. Filed October 9, 1895.

Comprises means for transmitting pulsations of successively alternate polarity to drive a receiving pen, a reversing relay operated by changes in the strength of the pulsations and a circuit controlled by the rapidity of the succession of the pulsations for preventing false operation of the reversing relay.

Telephones:—

TELEPHONE SYSTEM. G. Dillberg and P. Rabbidge, Sydney, N. S. W., 586,993. Filed September 9, 1895.

Comprises a speaking circuit, a call circuit, and induction coil having its primary and secondary coils in series in the speaking circuit and an armature controlled by the induction coil to control the call-circuit.

TELEPHONE EXCHANGE. M. G. Kellogg, Chicago, Ill., 587,004. Filed July 26, 1890.

The switchboard is divided into a calling and an answering section and circuits are provided for connecting the lines on the two different boards.

CALLING APPLIANCE FOR TELEPHONE SWITCHBOARDS. F. R. McBerty, Downer's Grove, Ill., 587,080. Filed November 12, 1895.

Embodies apparatus for transmitting selective signals in "party" telephone lines.

TELEPHONE EXCHANGE APPARATUS. F. R. McBerty, Downer's Grove, Ill., 587,081. Filed June 3, 1896.

Consists in interposing in the ground branches of the lines a number of polarization-cells sufficient to counteract any difference of potential on the line.

TELEPHONY. J. W. Gibboney, Lynn, Mass., 587,119. Filed July 26, 1895.

Syetem adapted to utilize alternating current.

TELEPHONY. J. W. Gibboney, Lynn, Mass., 587,120. Filed August 3, 1896.

Similar to above.

SWITCHBOARD ANNUNCIATOR. N. H. Holland, Montreal, Canada, 587,204. Filed September 5, 1896.

Details of construction.

TELEPHONE TRUNK CIRCUIT. J. J. O'Connell, Chicago, Ill., 587,226. Filed February 11, 1897.

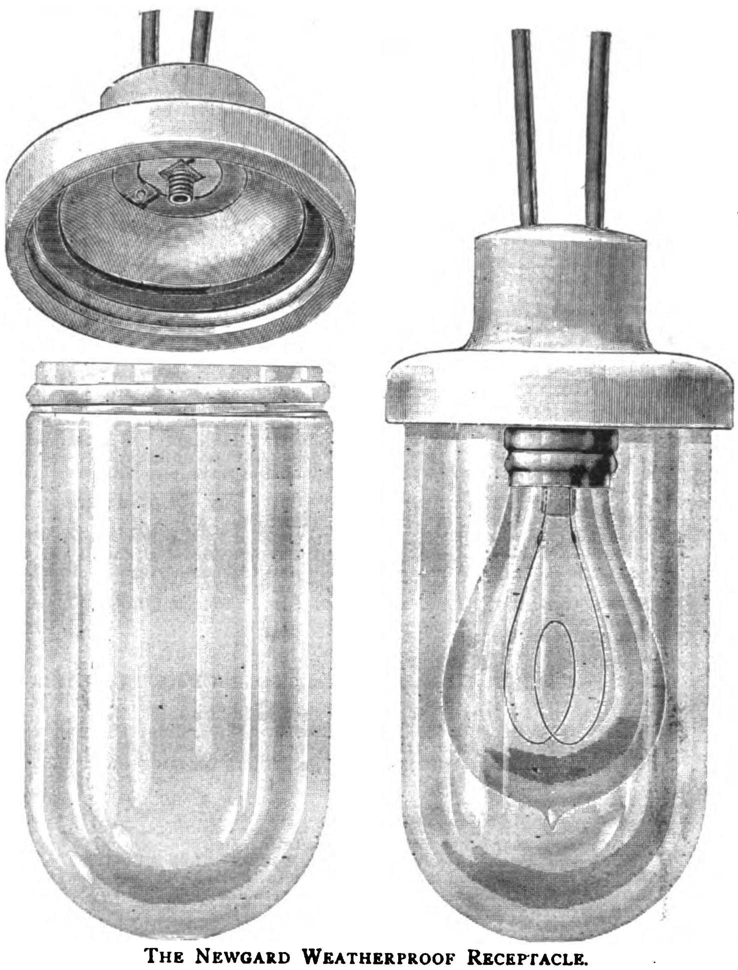
Means whereby the operators at both ends are enabled to display call and disconnecting signals at the key board of the other.

TRADE NOTES & NOVELTIES

THE NEWGARD WATER PROOF RECEPTACLE.

THIS is a combination of waterproof socket and waterproof globe complete in one appliance. As will be seen from the accompanying illustration, a single piece of porcelain forms a socket or receptacle for the lamp, and the cover for the globe. The conducting wires are permanently sealed in this porcelain cap, which is threaded into the receptacle, and the glass globe and rubber gasket in the cover makes a watertight fitting between the cover and the globe, making an outfit which can be used under water with perfect safety.

The Newgard waterproof receptacle finds its largest field of usefulness in breweries, packing houses and similar work where it is customary to wash the floors, walls and ceilings



THE NEWGARD WEATHERPROOF RECEPTACLE.

with showers of water. It is also said to be a perfect solution of the difficulty in all places where severe conditions have heretofore made a perfect insulation of lamp and socket an impossibility, such as cold storage warehouses, paper mills, etc.

The receptacle is made regularly with T.-H. base, but can be used with Edison lamp by use of a T.-H. adapter. The globe will take either a 16 or 32 c. p. lamp, the opening in the globe being 2¾ inches. The length of the globe is 6 inches, while 7 inches is the length of the outfit over all.

Although just introduced, several hundred of these outfits have already been placed in a number of Chicago breweries, and the results secured have been most satisfactory. The Newgard waterproof receptacle promises to come into very extensive use. The Electric Appliance Company, of Chicago, will be glad to give further information on this specialty.

THE VULCAN FOUNDRY.

With regard to the new Vulcan Foundry at Pawtucket, R. I., in which Mr. Gardiner C. Sims is interested, it is stated that the intention is to operate the plant throughout by electric motors, for which current will be supplied from the central station of the Pawtucket Electric Company. Other features of economy and convenience will abound.

BELL TELEPHONE OUTPUT.

The instrument statement of the American Bell Telephone Company for the month ended July 20 shows the net number of instruments put into lessors' hands as 8,618 against 9,588 the previous month, and 12,146 the month previous to that. The gross output for the month shows an increase of 2,975 instruments over last year, while the number of returns was 3,249 less, leaving a net gain of 6,524. For seven months 1,100 more instruments have been put out than last year, but these are increased to 2,920 by 1,820 less returns. The comparative instrument figures follow:

Month July 20.	1897.	1896.	1895.
Shipments	15,859	12,584	13,837
Returned	7,241	10,490	7,513
Net output	8,618	2,094	6,324
Since Dec. 20.	**1896-7.**	**1895-6.**	**1894-5.**
Shipments	127,778	126,678	98,896
Returned	51,847	53,667	47,121
Net output	75,931	73,011	51,775
Instruments in use	848,558	747,987	634,281

ELECTRICAL APPARATUS WANTED IN BRITISH HONDURAS.

The United States Consul at Belize, British Honduras, reports that the Municipal Board of Belize is contemplating the erection of an electric light plant for lighting the streets and public buildings of the city. He expresses the belief that there is an opportunity for American electrical manufacturers to install this plant. A telegraph line of about 200 miles in length is also to be constructed in the Belize consular district, and it is quite likely that a telephone line will be used in conjunction with it.

ADVERTISERS' HINTS

THE POTOMAC TERRA COTTA COMPANY, 36 Corcoran Building, Washington, D. C., advertise the Mason conduit for underground electrical subways. These conduits were described in our issue of July 29.

M. R. RODRIGUEZ, 19 Whipple street, Brooklyn, N. Y., calls attention to the fact that the "Premier Products" are not new on the market and the "Premier" motors, at $1.50 and upward, are guaranteed.

THE CENTRAL ELECTRIC COMPANY, 173-175 Adams street, Chicago, suggest to those participating in the return to prosperity to bear in mind that they are able to take care of orders at all times.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, note the advantages of the Newgard waterproof receptacle, combining a waterproof globe and socket. The fitting between globe and cover is made waterproof by a rubber gasket, making an excellent outfit for packing houses, breweries, etc.

KEUFFEL & ESSER COMPANY, 127 Fulton street, New York, supply everything required for blue-printing, drawing materials and instruments, surveying instruments, etc.

W. F. & JOHN BARNES CO., 281 Ruby street, Rockford, Ill., are making a special offer in lathes, which is well worthy of investigation by those interested.

STANLEY & PATTERSON, 32-34 Frankfort street, New York, have just issued one of the most complete catalogues of electric bell, battery and telephone and telegraph supplies which has come to our notice. They will take pleasure mailing one to any address upon application.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., say that for tin or shingle roofs and iron work, their graphite paint is absolutely without an equal. Tin roofs well painted with it have not required repainting for ten to fifteen years. They issue a circular regarding their paints which may be had for the asking.

NEW ENGLAND NOTES

THE LYNN INCANDESCENT LAMP COMPANY, Lynn, Mass., write as follows: "Our business is starting in well and there is prospect of large trade this fall. People are realizing that our lamp at 12 cents is in every way as good as the new lamp at combine prices. For the last few days we have averaged a little over 3,000, and orders are increasing."

THE UNITED GAS IMPROVEMENT COMPANY, of Philadelphia, are erecting at Atlanta, Ga., a water tower and tank. The tank has a capacity of 10,000 gallons, and is supported on a tower 60 feet high. They have let the contract for furnishing and erecting the tank and tower to the Berlin Iron Bridge Company, of East Berlin, Conn.

LAUNDRY IRONS.—Recent installations of complete outfits of electric laundry irons by the American Electric Heating Corporation, of Boston, are the Parker House and Young's Hotel, Boston; Milwaukee Hospital for Insane, Wawatosa, Wis.; Michigan Asylum, Milwaukee, Wis.

NEW YORK NOTES.

THE UNITED STATES ELECTRICAL SUPPLY COMPANY has been incorporated under the laws of the State of New York, with a capital stock of $10,000. The company have located at 120 Liberty street, with Mr. W. J. Clarke, formerly with the Adams-Bagnall Electric Company, as general manager. They are prepared to take contracts for the installation of all kinds of electrical plants, but are at present making a specialty of the W. J. C. arc and incandescent lamps, magnet spools for arc lamps, and a very complete line of X-ray apparatus and accessories.

THE ELECTRIC ARC LIGHT COMPANY, of 687 Broadway, New York, manufacturers of the "Pioneer" 150-hour enclosed arc lamp, continue to report booking satisfactory orders. A recent very large order is for the installation at the Seventh Regiment Armory, of New York City. This contract was awarded after a very severe test, the "Pioneer" coming off victorious.

KEASBEY'S MAGNESIA, furnished by Robert A. Keasbey, 54 Warren street, New York City, is the pipe and boiler covering used in the plant of the Union Traction Company, at Rutherford, N. J. This is but another addition to the long list of lighting or railway plants where this admirable specialty is to be found.

CHERRY ELECTRIC WORKS, 25-27 Third avenue, New York, have just issued a very neat catalogue and price list of their voltmeters, ammeters, fan motors and a number of other specialties of their manufacture. The reasonable prices at which these goods are offered will well repay interested parties to write to the Cherry Electric Company for their catalogue, which will be cheerfully mailed on application.

ONE OF THE most complete catalogues ever issued to the trade is that of Stanley & Patterson, 32 Frankfort street, New York, just out. It is the ninth edition of their electric light supply catalogue and contains 272 pages describing and giving prices on over 3,000 different articles used in electric lighting plants, most of which are illustrated. The firm will send the book gratis to any one upon application and receipt of business card.

"BUSY LINES" is the title of an interesting new circular just issued by the New Telephone Company, suggesting a "double track" system where one line is not enough, and showing how cheaply it can be carried out, even to the extent of a private branch exchange in one's office.

A CABLE ADDRESS DIRECTORY is being got up by a number of the officials connected with the Commercial and Postal Companies, among them Messrs. Bruch, Clapperton, Beck and Cuyler. This useful compilation will be a book of 600 pages, of which 100,000 copies will be printed. Names will be inserted by subscription only. The company's address is the Postal Telegraph Building, New York City.

STILES & FLADD PRESS COMPANY, of Watertown, N. Y., have just issued a very neat and handsome catalogue of their presses, drop hammers, dies, etc. It is well put together, neatly illustrated and full of useful information. As representing the growth of one year's business in this line, the catalogue is remarkable, as the first machine was shipped about May, 1896. A variety of small apparatus is included in the catalogue, which appeals to many classes of buyers.

LE VALLEY VITÆ CARBON BRUSH COMPANY, of New York City, has been formed, with a capital stock of $25,000, to make and sell an improved commutator brush and other electrical devices. The directors are D. A. Le Valley and J. V. Clarke, White Plains, N. Y.; E. J. Lewis, J. R. Hurnett and W. J. Creed, of New York City.

SNOW STEAM PUMP WORKS, of Buffalo, manufacturers of steam pumps, pumping engines and hydraulic machinery, have issued a useful catalogue of their 1897 styles of apparatus in that line. It is oblong,113 pages, and illustrates a large number of pumps of all sizes and styles for a very wide range of work.

PHILADELPHIA NOTES

W. H. WESTON & CO., 1303-9 Buttonwood street, Philadelphia, have just issued their illustrated catalogue, No. 5. It is an admirable exposition of their very fine work, and shows a wide range of apparatus for lighting and power switchboards, complete systems of stage regulating apparatus, and special appliances requiring skill in design and combination. Some of the devices illustrated have already received attention in these pages. This handsome pamphlet contains also a variety of useful data rendering it valuable as a book of reference.

WESTERN PENNA. TELEPHONE ASSOCIATION, at a recent meeting, decided not to join the National Independent Association at present. A committee, consisting of J. W. Jameson, of Newcastle; W. D. Watson, of Indiana, and A. W. Dively, was appointed to consider the construction of connecting toll lines.

READ-MORRILL ELECTRIC COMPANY has been formed in Philadelphia, with a capital stock of $10,000, by C. L. Reed, M. T. Morrill, J. W. Laws, H. C. Harmon and H. A. Harmon.

THE STERLING VARNISH COMPANY, of Pittsburg, Pa., have recently ordered a 75 h. p. Ball automatic engine for electrical purposes from the Ball Engine Company, Erie, Pa.

BALL ENGINES.—The Chesapeake & Ohio Railroad has ordered through Crook, Horner & Company, the Baltimore representatives of the Ball Engine Company, Erie, Pa., two Ball engines for electrical purposes. One of these engines is direct connected to a generator. The engines will be used at Newport News, Va.

WESTERN NOTES

FOSTORIA, O.—The capital of the new Crouse-Tremaine Incandescent Lamp Company is $50,000, all paid up. The factory will shortly be started with a capacity of 5,000 lamps per day. The officers are as follows: J. B. Crouse, president; R. Crocker, vice-president; H. A. Tremaine, secretary and treasurer. These are directors, with Ira Cadwalader and B. G. Tremaine, of Cleveland, O.

PACIFIC ELECTRIC COMPANY, La Crosse, Wis., have secured possession of a clever device called "the electrical trick," by which a piece of money can be made to disappear in the most mysterious manner, so that a very clever person would fail to detect how the illusion is accomplished. The company use it to advertise their shade lamps and dental lamps, and will be pleased to send it to any one who will write for same and will enclose four cents to cover cost of mailing.

UNION STORAGE BATTERY COMPANY.—Articles of incorporation of the Union Storage Battery Company, of Cleveland, have been filed with the Ohio Secretary of State. The capital stock is $10,000, and the incorporators are F. C. Phillips, G. A. Ford and G. N. Surridge, all of Cleveland. Mr. Phillips is well known as the general manager of the Elwell-Parker Electric Company. Mr. Ford has done a great deal of useful work in the storage battery field.

NATIONAL AUTOMATIC TELEPHONE COMPANY has been formed at Salina, Kan., to make telephones and switchboards of the Lundquist type. The officers are: W. W. Watson, president; F. A. Lundquist, vice-president; J. Anderson, secretary, and E. W. Ober, treasurer. The system is already in use at Sterling, Kan., and several other towns propose to put it in. The capital stock is $100,000. The factory will be at Salina.

UNION IRON WORKS, of San Francisco, are reported to have placed an order for $142,000 worth of Chloride accumulators.

SMYTH ELECTRIC COMPANY has been formed at Pasadena, Cal., with a capital stock of over $300,000. The directors are G. F. Kernaghan, B. F. Ball, H. M. Dobbing, R. Eason, D. M. Smyth, J. E. Smythe and A. R. Metcalfe.

THE OHIO ELECTRIC WORKS, of Cleveland, Ohio, has been purchased by A. C. Fletcher, who has been the company's president and largest stockholder. The plant is to be enlarged but the business will be continued on about the same lines with the exception that about September 1 a table lamp will be added to the line. This lamp will be illuminated by a primary battery similar to that used in the bicycle lamp manufactured by the company.

RICE MACHINERY COMPANY, of 166-174 South Clinton street, Chicago, have issued an excellent book devoted to their power transmitting appliances, elevating and conveying machinery, of all classes. It runs a length of nearly 300 pages, and is most profusely illustrated, the data given being also most complete and exhaustive, so that central stations, electric roads, isolated plants, electrically equipped factories, and other places where power appliances are in use, can order intelligently and safely from the catalogue alone. The Rice Company are general agents for the celebrated Dodge Independence wood-split pulleys and other Dodge specialties.

BROWNLEE & CO., of Detroit, Mich., the well known manufacturers of cross-arms, oak insulator pins and wooden trolley poles, write: "The circulation of The Electrical Engineer seems like Puck's girdle, to go 'round the earth.' We have just received an inquiry, with mention of your paper, from Liege, Belgium."

GALION, O.—The Electric Signal Clock Company has been formed with a capital stock of $25,000.

THE OHIO TELEPHONE CONSTRUCTION COMPANY is is the new corporate title just adopted by the former Ohio Harrison Telephone Construction Company, of Norwalk, O.

JAMES LEFFEL & CO., Springfield, Ohio, have issued a neat, new pamphlet, "D," replete with numerous illustrations and descriptions of the throttling and automatic engines, with portable and stationary boilers, which they are building in a variety of sizes and styles. Copy is sent free to parties interested, on application to the company.

THE ELECTRICAL HOUSE goods department in the electrical supply business has been more or less neglected during the past few years, owing, largely, to the prominence taken by the electric light and power department of the same business. The Electric Appliance Company pride themselves upon the fact that the electrical house goods department of their business has always had good attention, and particularly during the past six or twelve months. The house goods department in the new issue of their general catalogue is to be exceedingly complete, and the company claim that they will list the most complete line of house goods ever catalogued.

DUBUQUE, IA.—The Inter-State Telephone and Electric Company has filed articles of incorporation. The new company is incorporated, with a capital stock of $100,000, for the purpose of constructing a plant for the Dubuque Telephone Company and building also toll lines into the city. The officers of the corporation are F. F. Sapp, of Chicago, president; E. T. Keim, of Chicago, secretary, and R. W. Stewart, of Dubuque, attorney. The general business of the company is to be the constructing, acquiring, operating, buying and selling of telephone exchanges, instruments, etc. Mr. Sapp, who is the president of the company, is a wealthy Chicago capitalist.

MR. W. D. MYERS, manager for thte Union Telephone Company at Peoria, Ill., has joined the company's engineering force at Chicago and has been succeeded by Mr. E. J. Garland, of Springfield, Ill.

ST. LOUIS, MO.—The plans for the exchange switchboard, etc., of the Kinloch Telephone Company have been furnished by Mr. Milo G. Kellogg, of Chicago, who is also building the board.

MR. M. M. WOOD, who has been for some time past associated with the Ohio Brass Company, Mansfield, Ohio, has accepted the position of electrical engineer to the Central Union Brass Company, St. Louis, Mo. Mr. Wood is the inventor of Wood's railway material, and now has a complete line of overhead specialties, which the Central Union Company will shortly bring out, and which are not in any way affected by existing patents. The company will also manufacture and sell the well known "Type W" material and push hard for a good share of the trade among electric railways. Mr. Wood has the best wishes of his many friends for success in his new position.

J. HOLT GATES, Western agent of the Walker Company, has removed his offices to suite 1323 and 1324 Marquette Building, where he has much larger quarters. Mr. Gates also reports that he has taken the Western agency of the Wagner Electric Manufacturing Company's alternating current transformers, single-phase alternating current motors, alternating current instruments, switches, etc. Mr. Gates has also taken the Western agency of the Card Electric Company, of Mansfield. Ohio.

SOUTHERN NOTES

W. B. UPTON & CO. have opened an office in the Washington Loan and Trust Building, Washington, D. C., for the purpose of conducting a general engineering and contracting business, electric and hydraulic plants being a specialty. Mr. Upton is known in connection with several large installations.

BALTIMORE, MD.—The Baltimore & Ohio Railroad has just completed on Henderson's Wharf a six-story tobacco warehouse which has more floor space than any other building in the city. It cost about $150,000, is equipped with all modern machinery for handling tobacco and has four electric elevators. The building is fireproof and electric lighted.

THE MT. WASHINGTON ELECTRIC LIGHT AND POWER COMPANY, Mt. Washington, Md., have recently increased the capacity of their station by adding a 100 h. p. engine, built by the Ball Engine Company, Erie, Pa., being the third engine of this manufacture now in this station.

THE MT. VERNON COMPANY, Woodberry, Md., have recently purchased from the Ball Engine Company, Erie, Pa., a 100 h. p. Ball automatic engine, being the second order for this make of engine.

CROWLEY, LA., is to spend $30,000 on municipal waterworks and electric lighting plant.

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Department News Items will be found in advertising pages.

The Electrical Engineer.

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MISCELLANEOUS

THE ELECTRIC FURNACE.—I.

BY LIEUT. F. JARVIS PATTEN.

THE highest terrestrial temperature known to science, about 6,000 degs. F., is that required to fuse and volatilize carbon, and is only found in the electric arc. It is not at all surprising therefore that soon after the electric arc became a manageable thing its application to heating and fusion were thought of, hence the electric furnace. In fact, down to the present time, although this application is nearly twenty years old, the most advanced forms of electric arc furnace in use are little more than simple mechanical contrivances for maintaining a very powerful arc between electrodes and other ordinary contrivances for getting the material to be treated into the arcing space and keeping it there.

To-day the furnace is the least developed invention in the electric arts, although it doubtless has a great future and

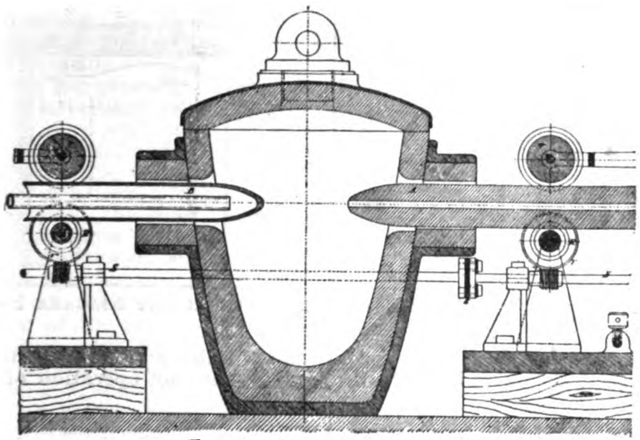


FIG. 1.—SIEMENS FURNACE.

opens a new field to the inventor not only in the perfection of the furnace itself, now an extremely crude affair, but the field is also alluring in holding out as it does the promise of giving to the world of science new combinations of matter, as well as that of producing rare and difficult chemical combinations upon a cheap and commercial scale. It is probably because this possibility has but recently become known that the electric furnace has received so little attention, and has therefore remained comparatively unimproved for twenty years.

The possibility of making calcium carbide on a commercial scale by electrically heating the ingredients, lime and coke, to the required temperature of combination, was its first great achievement and gave an immediate and lasting stimulus to electric furnace working, and we may soon expect to see a new born engine of science capable of applying the highest possible temperatures to chemical reaction.

As chemical affinity or attraction, determining which elements unite, is purely a question of temperature, so it may be well said that there are to all intents and purposes different chemistries at different temperatures.

Thus, through a wide range of temperature above and below normal, carbon's strongest affinity is for oxygen; but at the temperature of the electric arc the greater part of the carbon present in a mixture of lime and coke, unites with the calcium of the lime to form carbide of calcium (CaC_2), only a small portion uniting with the oxygen present to form carbonic acid gas (CO_2), as indicated by the formula for making calcium carbide, as follows:

$$2CaO + 5C = 2CaC_2 + CO_2.$$

The electric furnace may indeed prove a storehouse of surprises for both the scientific and the commercial world. Moissan has made diamonds by its aid, and, although they are not as yet a commercial article, there is little reason to doubt that in time they will be.

Historically the electric furnace dates from the seventies, and, though it is difficult to say when it was first mentioned or used, the first patent of record describing such an apparatus that I have been able to find bears the name of Charles William Siemens and is dated 1879. The principal drawing of the patent is here reproduced in Fig. 1, and shows simply an ordinary crucible with internally projecting electrodes for

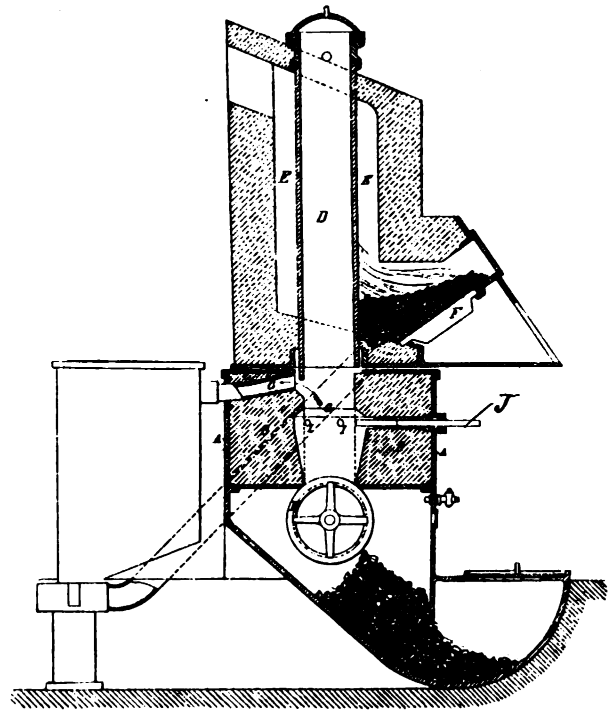


FIG. 2.—FAURE FURNACE.

establishing an arc within. The following excerpt from the specification describes all the essential elements of the modern electric furnace, although this one is, strictly speaking, only an electric crucible.

"In applying the electric current to the production of intense heat for the fusion of refractory substances I employ two carbon rods, fitted to slide toward each other horizontally, within water cased tubes, which are attached to the

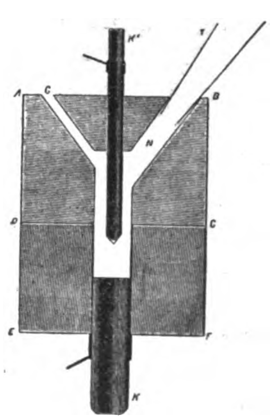


FIG. 3.

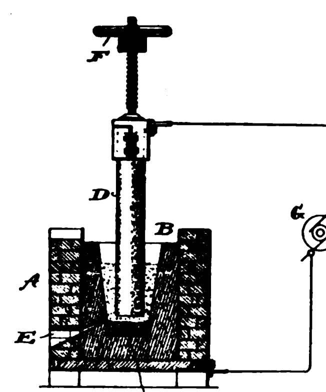


FIG. 4.

opposite sides of a crucible made of highly refractory material, such as lime or alumina, also water cased if necessary.

"The substance to be fused is introduced into the crucible, and the carbon rods are advanced sufficiently near to each other to form the voltaic arc within the crucible. They are thereafter made to advance by clockwork, each at a speed proportioned to its rate of consumption, so as to maintain the arc always within the crucible. As the heat in the crucible increases, the resistance to the voltaic arc within it diminishes, and consequently the arc can be elongated, an ef-

fect which results from the automatic retardation or stoppage of the feeding clockwork. In some cases, instead of employing carbon for the terminals, they may be made of the material that is to be fused, when it has sufficient conductivity."

The second in chronological order is, in fact, an electric furnace, and bears the equally illustrious name of Camille Alphonse Faure. His furnace is shown in Fig. 2, and is described as being adapted to the smelting of iron and other ores. In the figure a number of electrodes, J, project radially into the center of the furnace through holes, I, I, etc., and through the arcs maintained between them the material to be treated is caused to fall. There is no evidence that this system of furnace ever found general use. The patent is dated in 1882. So much for history.

The ordinary electric furnace of to-day finds its expression in some modification of that shown in Fig. 3, which represents a good form of furnace for laboratory work. There are two electrodes or circular carbon pencils, K and K', the one in the base of the furnace being fixed, the other being movable vertically. The furnace proper is made of two blocks of lime placed one above the other and separable along the line, C D, so that the contents can be readily removed when the operation of fusion is completed. A tube, S, permits feeding the material to the arc and the vent, G, allows the gases to escape.

It is but a step from this form to that shown in Fig. 4, the early form of the Willson and other American furnaces. In this type a fixed block of carbon, C, placed in the base of the furnace chamber, forms the lower electrode and a movable carbon pencil, which may be eight or ten inches in diameter, is the upper electrode. The tuyere pipe, E, allows the product of fusion to be drawn off when it is of a sufficiently fluid character to flow freely.

It is an easy step to pass from this form to the historic Willson furnace of Spray, North Carolina, shown in Fig. 5, and in which, it is believed, carbide of calcium was first made on a commercial scale from a mixture of lime and coke, as per formula given above. This furnace had electrodes of rectangular cross-section, about ten by twelve inches, and the output of a single run was a nugget of carbide some two or three feet high and a little over two hundred pounds weight. The first lot of electric furnaces at Niagara Falls turning out nuggets of about eight hundred pounds each differ in no material particular from the one at Spray shown in Fig. 5, except in matter of size and output. More recent developments, however, have introduced numerous innovations, and the tendency is to constantly increase the size and output of the furnace. While no new principles of operation have as yet been introduced into commercially working furnaces to

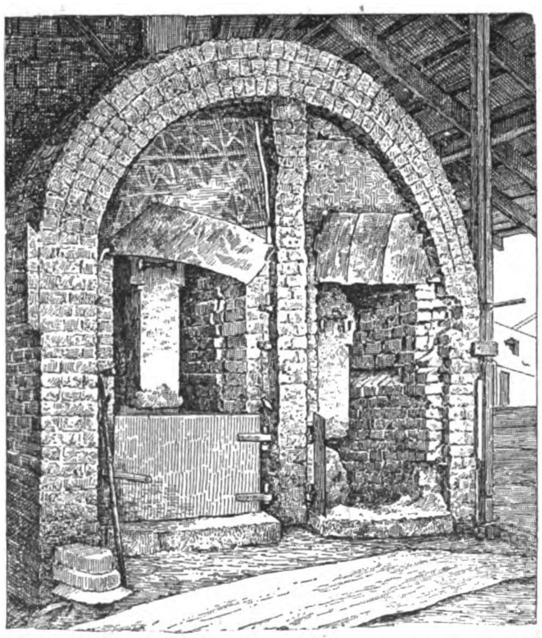


FIG. 5.—WILLSON CARBIDE FURNACE AT SPRAY, N. C.

my knowledge, they will doubtless make their appearance at an early day.

The recently constructed furnaces at the Niagara Falls plant for making carbide are designed as 1,000 h. p. units, and turn out a nugget of from 800 to 1,000 pounds at a single operation. These stacks are about thirty feet high, and are built on the general lines shown in Fig. 6. In this form a hinged base, D, forms a lower electrode, and its removal to the downward hanging position allows the product of an operation to be dumped into a cart that is run in under the furnace. The upper electrodes are counterweighted and movable

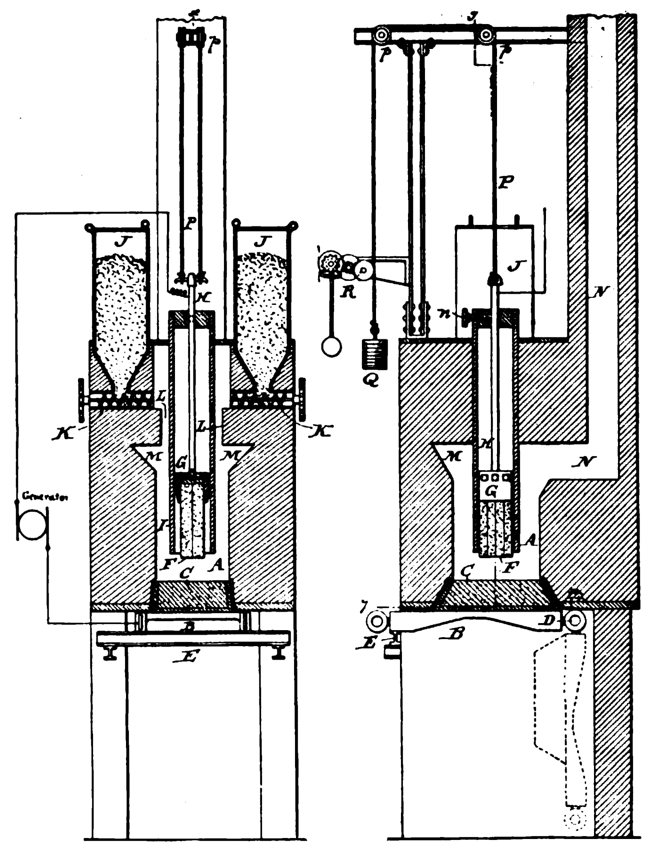


FIG. 6.—IMPROVED WILLSON CARBIDE FURNACE AT NIAGARA FALLS.

as indicated. Hoppers, J, J, contain the material for treatment, which is fed into the arcing space by operation of the driving screws, K, K.

ELECTRICAL MACHINE SHOP PRACTICE.—IV.

BY JAMES F. HOBART, M. E.

EVEN as simple a thing as driving a small lathe by means of an electric motor, is not always done as it should be, even in the machine shop. What conditions of arrangement are then to be expected in manufacturing shops?

Fig. 14 shows something of this kind. A small lathe, of about 10-inch swing, 3 feet between centers, was put in for the purpose of making repairs to arc lamps, and a motor was put in to drive the lathe, the arrangement being as shown in the engraving. This is a very common arrangement when small motors are put in to drive machinery; and it is a very bad arrangement. The pull comes all on one end of the shaft, and the action is to tip up one end, throwing it out of line and causing the belt to run off, to say nothing of the possibility of pulling the armature against the field of the motor as the wearing continues.

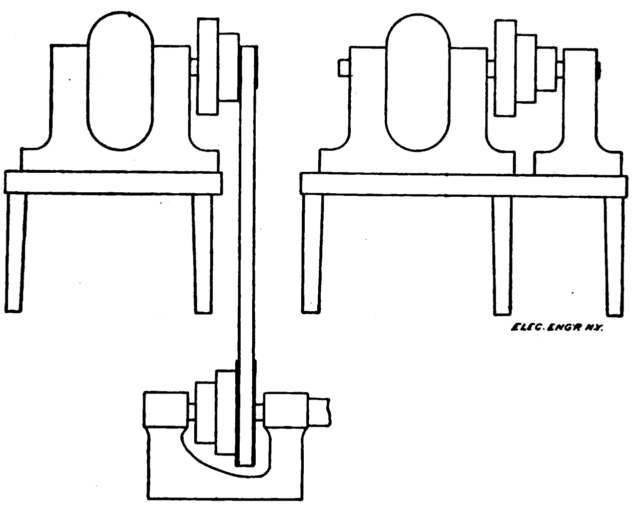
The arrangement is a very bad one, and should never be used. Another bearing should be made outside of the pulley, and it would be an excellent point for the makers of small motors to consider the matter of making long base frames for their machines, to be had at will, and carrying an outside standard, or pillow block. The wearing down tendency was only corrected in this machine by extending the wooden shelf as seen in Fig. 15, and putting another bearing outside the step pulley. The shaft had to be lengthened for this, but that was only a little blacksmith and machine shop work.

The making of electromagnets, particularly the kind with hard rubber heads as used for telegraph instruments, is a matter that requires a good bit of special machinery to make them profitably in large quantities, but for a few, or even a few hundreds, some jigs can be rigged up to do the work at pretty low cost.

Fig. 16 shows one of these magnets. It consists of the soft iron core, into the end of which some non-magnetic metal has

been placed as indicated by the small circle in the end of the magnet core. This is to keep the armature from sticking, "freezing," the telegraphers call it, when current is broken in the magnet winding.

The hard rubber heads are pressed on, the friction between



FIGS. 14 AND 15.

the rubber and the iron core being all that holds, or that is necessary to hold them in place.

The heads are shown by Fig. 17, the finished head, a, being ready for pressing on the core. The shape, b, shows a head as it is pressed out of a sheet of hard rubber. It is simply a plain disc without a hole in it. Or, the discs may be sawn off of a hard rubber rod of the required size.

The chuck, shown in Fig. 18, is screwed to the spindle of a Fox, or a turret, lathe. The spindle of such a lathe is shown at a, with the split chuck, b, put into it. This chuck is also made hollow, and a hollow plunger, c, fits inside of it. The spiral spring, d, serves to keep the plunger in place; also to force out anything that might be in the chuck when it is opened. There is a little shoulder in the hollow chuck just back of the plunger which prevents the plunger from being pressed back more than a certain distance. The thread on the chuck is taper, and the circular nut, e, is turned by the handle, f, which is left in place when the lathe is running.

To use this chuck, one of the hard rubber blanks, b, Fig. 17, is pressed on at a time, a pair of special chucks being used, against the shoulder. The blank is held in place while the nut is screwed home. Then the lathe is started up, and the turret tools soon make a finished magnet head out of the hard rubber blank. The operator soon becomes so expert that he can hold the blank in with one hand, and hold the nut lever, too, while he starts the lathe with his other hand, letting the first few turns of the spindle do the screwing up of the chuck. This tool is self-clearing, the finished head being expelled by the plunger as soon as the chuck is opened.

Another little kink is in putting the heads on the cores; the heads are forced on by screw pressure, an ordinary lathe spindle being used for the purpose. In one method, one head is pressed on at a time, a pair of special chucks being used, the one put into the live spindle being fitted to receive one of the rubber heads, and the little chuck that is placed in the tail spindle looks just like a small drill pad, and is cupped about a 1-16th of an inch to receive the end of the magnet core. In fact, the tail chuck is cupped to exactly the distance that it is desired the cores to project beyond the hard rubber heads. When the cores bring up in the bottom of each chuck, there is no more pressing to be done on that magnet; hence, they are all pressed on exactly alike.

Another jig that is used where there are many magnets of the same size to put up, consists of a brass casting built on the same principle as the babbitting jig, Fig. 11 (see The Electrical Engineer of July 15), and the iron core is laid on some bearings which hold it just high enough to come central with a couple of heads which are slipped into recesses, one at either end of the core. The three pieces being in place, the tail spindle is forced up, and a plunger attached to it, forces the heads into place, both at the same time. This rig is a time saver, but it cannot be used for several sizes and lengths of bobbins, as the first described rig can.

Working hard rubber is one of the things that the electrical machinist has to do, and the tools that can be profitably used in such work are varied. Some of the sheets of hard rubber can be cut with any circular saw as freely as wood, but other sheets will take the teeth off a saw as fast as it can be filed. In such sheets there seems to be a kind of grit which works about like emery. Sheets of this kind should be rejected. It does not pay to work them.

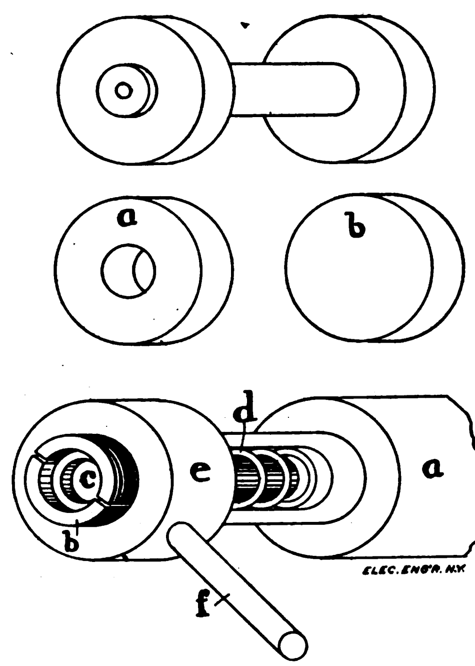
For working the better class of hard rubber sheets, a saw with teeth not over ¼ of an inch pitch should be used, and the saw need not be over 1-16th of an inch thick, and 4 or 5 inches in diameter. The teeth should all be filed square across, then the points will be like little chisels, and cut all along their length, instead of only at the very point, as is the case where the saw teeth are filed "fleaming"; that is, with the outside of the tooth the longest. This is the form of filing used for cutting crosswise of the grain in wood. Some saws are filed a little that way for splitting wood, but for the hard rubber business, file exactly straight across and the saw will cut better and stay sharp longer. Too much attention cannot be given to this point.

The set of the saw should be very slight. Only barely enough to permit the body of the saw to pass without sticking should be allowed, and what set there is should be given by bending out almost the whole tooth, instead of merely the point, as is often done by some saw filers. In addition to these points, the saw must be very true sidewise, without lumps or bunches, and it must, furthermore, be as round as it is possible to make it by holding a bit of emery stone squarely against the saw every time it is to be filed.

In connection with this matter, the saw must be a good fit on the mandrel. If too large, a bushing should be dovetailed in, and kept there by riveting. There is a way of using a saw too large for the mandrel, but it is not a sure one unless a great deal of care is taken by the workman to handle the saw in exactly the same manner every time he puts it on the mandrel, as follows:

Make a mark on the saw, using a center punch for the purpose, or, as some men do, take the maker's name as a mark, but the center punch mark is the best, for it allows a similar mark to be made on the mandrel collar, whereas if the maker's name be used, there is a chance of making a mistake. But whatever marks are used, bring them both uppermost, on saw and collar, then place the saw carefully in place with the marks in the position described, put the loose collar in place, and screw up the nut, keeping the marks directly on top all the time.

The principle of the matter is: If both marks are kept on top, the slack in the mandrel hole will be directly downward, and if the saw is rounded up while in this position, it can be replaced exactly again, by keeping the marks uppermost at the time of putting on the saw. If the mandrel were known to be perfectly true, there would be no necessity for marking



FIGS. 16, 17 AND 18.

that, but as there are often some dents to be found in the mandrel, the precaution must be taken of keeping it in one position also, when arranging the saw.

A large part of the work devolving upon the regular machinist in electrical work is the making of dies and jigs for the duplication method of manufacture. To this end a great deal

of grinding of hardened steel has to be done, and for plane surfaces there is nothing better than to rig one small or medium-sized planer permanently for this work.

Get a revolving vise that can be bolted to the top of traveling platen, and is graduated so as to be set to any required degree. Remove the tool box from the saddle and put in its place an emery wheel so hung that it can be turned to cut in almost any plane, from vertical to horizontal. Special machines of this class are in the market, but it is often desirable to make use of one on hand. But before deciding to make any planer into a grinding machine, test the planer thoroughly to make sure that the platen travels true.

If there have been bunches worn in the ways, or hollows ground down in them, all these imperfections must be removed by planing up the bed and ways, before a good job of grinding can be done on the machine after it is altered to suit the new purpose. A planer, or a plane surface grinder, will reproduce in the work it does each and every one of the imperfections that exist in the platen or in its slides.

Any machine that has been set apart for this kind of work, in order to keep it so as to do good work, must be so arranged that the dust from the emery wheel will not, and cannot get on to the sliding surfaces. To secure this end, it may be necessary to arrange a hood over the wheel, or over a certain part of it, so as to catch the emery and metal dust as it leaves the wheel. If this funnel or hood be also connected with a small exhaust fan, the work done will be much better, and the life of the workman in charge of the grinding machine will be considerably prolonged. Emery dust is very bad when drawn into the lungs.

ROTARIES FOR TRANSFORMING ALTERNATING INTO DIRECT CURRENT.[1]—I.

BY C. F. SCOTT.

THE characteristic of alternating current which gives it a high commercial value is the facility with which it may be transformed from one pressure to another. An electric system may combine both the advantages of the alternating current for transmission and of the direct current for utilization, if there is a means of transforming alternating into direct current.

Methods of Transformation.—The simplest arrangement of ordinary apparatus for transforming from alternating to direct current is found in an alternate current motor driving a direct current dynamo. The two machines may be mechanically connected by belt or otherwise, or the two armatures may be mounted upon one shaft and the two fields placed upon the same bed plate. The arrangement may be further simplified by using a single field and a single armature with two windings, one for receiving the alternating current and the other for generating the direct current. A further simplification is made by uniting the two windings into a common winding suitably connected both to collector rings for receiving the alternating current and also to a commutator for delivering the direct current. This arrangement constitutes the ordinary rotary transformer, rotary converter, or rotary such as has been finding a widening and important practical application during the last few years.

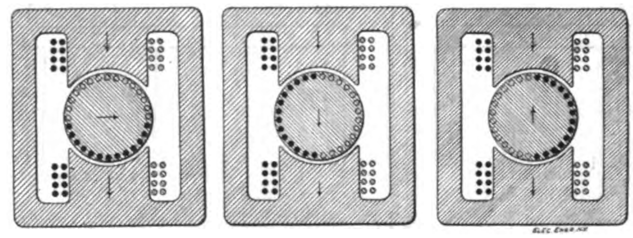
An armature for a rotary may readily be made from the armature of a direct current machine by connecting collector rings to certain commutator segments, or to the points in the winding to which they are connected. The part of the armature winding between two collector rings is continuously changing position with reference to the field poles and is, therefore, generating a continuously changing e. m. f. which appears as an alternating e. m. f.

The ordinary rotary is a combined alternating current motor and direct current generator. It possesses certain characteristics of a motor, others of a generator and still others which result from the combined action of the two. The characteristics of the synchronous motor will be considered in detail, then those of the direct current generator and finally those of their combination or a rotary.

A Synchronous Motor.—If two similar alternating current machines be driven from the same counter-shaft at the same speed and have the same field charge, they may be connected together in multiple in the same way that two similar direct current machines running at the same speed and with equal field charges may be connected in multiple. If the belt be thrown off one of the machines it will run as a motor, receiving its current from the other machine.

A motor which receives current from a supply circuit must conform to the characteristics of that circuit. A direct current shunt motor for example must run under such conditions that the e. m. f. of its armature is equal to the e. m. f. of the supply circuit. This means that the speed, the field current and the work done must be mutually adjusted in such a way as to meet these conditions. If the field current is reduced the speed will increase; if the load be increased the speed will, in general, decrease.

In like manner a synchronous alternating current motor must adapt itself to the conditions of the circuit, not only in e. m. f., but in speed. It must run at a definite constant speed which is in a ratio to the speed of the generator determined by the relative number of field poles in the two



FIGS. 1, 2 AND 3.

machines. A change in the field charge of a synchronous motor cannot be compensated for by a change in speed as is the case in a direct current motor.

Effect of Variations in Field Strength.—If the field current of the alternating current motor be reduced there can be no increase in speed and there must necessarily be some other means for making the e. m. f. of the motor correspond to that delivered by the generator. If the field charge of the motor be decreased, say 20 per cent., it will be found that a very considerable current flows between the generator and the motor, possibly equal to the full load current of the motor. This current is evidently a so-called "wattless" current for, although it is delivering apparently the energy required by the motor at full load, it is actually delivering only sufficient energy to run it without load. The current flowing is, however, different from the current which flows when the motor is loaded under normal conditions, as the two currents do not have the same time relation to the e. m. f. In a loaded motor under normal conditions the maximum current occurs at the time of maximum pressure and zero current at the time of zero pressure.

The position of the armature at the time of maximum current is shown in Fig. 1. The armature conductors which are shown in black circles are those carrying current in one direction, while those shown as open circles are those carrying current in the opposite direction. The armature is in a two-

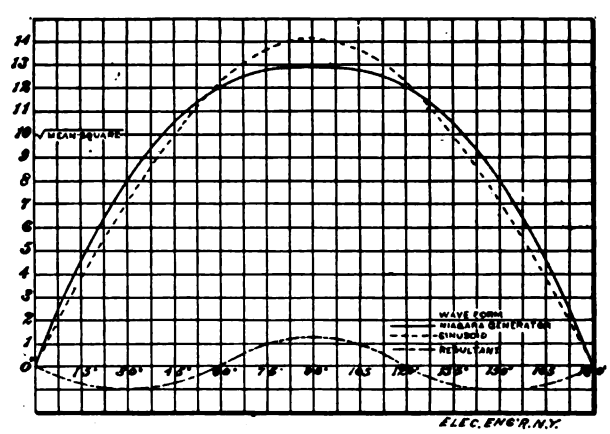


FIG. 4.—TWO-WAVE FORMS AND THEIR RESULTANT.

pole field and the direction of the current in the field coils is represented in the same way, by dark and light circles.

When a motor with a low field current is connected with a circuit and receives a heavy armature current, this current does not flow simultaneously, or in phase, with the e. m. f. The maximum current occurs when the armature has revolved through 90 degrees (in which position the e. m. f. generated is zero). The position of the armature at the time of maximum current is shown in Fig. 2. It will be readily seen that in this position all the wires which carry current in one direction are on the same side of a line running through the middle of the field poles, and that the armature current is in a posi-

[1]Abstract of a paper read before the National Electric Light Association at Niagara Falls.

tion to directly aid the current in the field winding in its magnetizing effect as is indicated by the arrows. This is equivalent to strengthening the field current. If the field current of the motor be reduced 20 per cent., and the e. m. f. of the circuit remain the same, then there will be sufficient current through the armature to make up for the 20 per cent. reduction in the ampere turns in the field.

In the generator, however, the position of the armature coils when this current flows is such that it acts against the current in the field, thus reducing the effective magnetization. The position of the conductors at the time of maximum current is shown in Fig. 3, in which the magnetizing effect of the current in the armature is seen to be directly opposed to that in the field. If the generator is large in comparison with the size of the motor, the effect may be small, but if the motor be large it may be considerable. If the two machines be of the same size and the e. m. f. of the generator is 1,000 volts and that of the motor 800 volts before they are joined, then the resulting e. m. f., when the motor is connected to the generator, will be about 900 volts. The current flowing through the two armatures will reduce the magnetization of the generator by opposing the ampere turns of the field, while in the motor the magnetization will be increased as the armature ampere turns assist those of the field.

If the field current of the motor be increased so that its e. m. f. before connection to the generator is, say, 1,200 volts, then a current will flow which demagnetizes the motor and magnetizes the generator. If the two machines be of equal size so that a current produces about equal effects in the two machines, then the resulting pressure will be about 1,100 volts. It is in fact possible to run a motor without any field charge at all, but with an armature current sufficiently large to produce all the magnetization required. On the other hand, it is also possible to run a motor having a charged field from a generator which has no field charge. The current in the armature magnetizes the generator while reducing the e. m. f. of the motor. In this case the e. m. f. at the terminals is about half the e. m. f. which there would be if the generator had its normal field charge.

When a motor is running with load, the current which delivers energy to it is in phase with the e. m. f. and produces only a slight effect upon the magnetizations and e. m. f.'s of the machines. When a motor is carrying load the current to it increases if the field be too high or too low, as the e. m. f. of the motor must be made equal to that of the circuit by an additional magnetizing current in the armature if the field current is not properly adjusted. These conditions are illustrated by the relative directions of the arrows in the first three figures.

In the illustration, which has just been cited, it has been assumed that there is little or no resistance in the circuit joining the generator and motor. If, however, there is a considerable resistance in the circuit between the two machines, then the e. m. f.'s on their terminals will in general not be the same, that of the motor will usually be lower than that of the generator, as it is in direct current circuits. It is possible, however, if there be inductive resistance in the circuit between the two machines, and if the field charge of the motor be increased, to make the e. m. f. at the motor terminals equal to or greater than that at the generator. If the field current of the motor be increased as it is loaded, the e. m. f. at the motor may be maintained constant at all loads or may be increased as the motor is loaded. On the other hand, if the field current of the motor be too low there may be a greatly increased drop in generator and in transmission circuits. There is always a certain definite motor field charge with which the motor will carry its load with a minimum current.

Any variation in field charge increases the current required by the motor and this current, although it may be useful for regulating the e. m. f., causes increased heating and losses in the armature usually and the transmission circuits also.

Effect of Variations in Wave Form.—The e. m. f. of a synchronous motor must be adapted to that of the circuit not only in its average intensity, but also in its wave form. Two alternating current machines may give equal e. m. f.'s of, say, 1,000 volts effective, although one has a maximum e. m. f. of 1,410 volts and the other of only 1,290 volts. At some other part of the wave, say when the e. m. f. of the first machine is 700 volts, that of the second machine may be greater, or 800 volts. The result is that at some instants the first machine would have an e. m. f. over 100 volts higher than the second machine, and at other times the second machine would have an e. m. f. higher than the first. If two such machines be run in synchronism, either both as generators or one as a generator and the other as a motor, the difference between their e. m. f.'s at different times during each alternation gives an e. m. f. for sending a current back and forth between the armatures. This e. m. f. is one of a higher frequency than the normal frequency of the circuits usually of three or five times the frequency, and it evidently cannot be avoided by changes in the field charges of the machines. This high frequency current causes extra heating in the armatures and transmission circuits, it reduces output, it causes increased drop and it contributes to "pumping."

The figures used in the foregoing example are taken from the published curve of the Niagara generators and the sinusoid. The result indicates what may be expected if a machine whose e. m. f. wave is a sinusoid be connected to the Niagara circuits. This is illustrated in Fig. 4, which shows the Niagara wave, the sinusoid and their difference, or the e. m. f. which would send an idle current through the circuits. This is equal to about 10 per cent. of the normal e. m. f. of the circuit.

Effect of Variation in Speed.—The effect which a given difference of speed makes upon the electric system depends largely upon the number of poles of the alternators. The variation in speed may be such that one armature is at times 1-100 of a revolution in advance and sometimes 1-100 of a revolution behind a second armature. If the machines have 100 poles then the one armature which at one instant agreed in phase with the other, so that its e. m. f.'s will be of exactly the wrong phase and a heavy current will flow through the armatures. If, however, the alternators be two pole machines, then an advance of only 1-100 of a revolution of one armature ahead of the other will cause so trifling a difference in e. m. f.'s as to produce little or no appreciable effect.

"Pumping" of Motors.—This irregularity may be caused by variation either in speed or in e. m. f. Variation in the speed of a generator tends to cause a corresponding variation in the speed of a synchronous motor. The motor cannot assume instantly the speed required by the new speed of the generator. When this increases then the motor armature begins to increase in speed but lags slightly. At this time the motor receives an increased current because its armature is not in the normal position for the new frequency and because additional current is required for supplying the energy necessary for increasing the speed. The additional current produces a difference in the magnetization of the field, which must again be altered when the generator speed decreases below the average. The motor is, therefore, undergoing a slight variation in speed which does not exactly correspond to that of the generator, and it is undergoing changes in its magnetic field strength which cause it to receive from the circuit a fluctuating current, and this may in turn affect the e. m. f. upon the circuit. The motor armature at certain times receives more than its average amount of energy from the circuit and at other times may even return energy to the circuit. The e. m. f. of the circuit is dependent, not upon the generator only, but upon the combined action of the generator and the motor, and the fluctuating current to the motor may produce a fluctuation in the e. m. f. of the circuit. A fluctuating e. m. f. upon a circuit, such as would cause a flickering or varying light in an incandescent lamp, will cause a motor to take an additional current either lagging or leading at each variation.

Torque at Low Speeds.—A synchronous motor possesses but little torque at any speed except the synchronous speed. In general it cannot be started except by the use of some auxiliary apparatus or at the expenditure of a heavy current in proportion to the torque developed. It must be connected to the circuit or "synchronized" when it has attained exactly the proper speed, when the e. m. f. is equal to that of the circuit and has the right phase relation. When it is slightly below synchronism its torque is greatly reduced. A momentary overload upon the motor may cause it to drop from synchronism.

Resumé of Characteristics of a Synchronous Motor.—Among the characteristics of a synchronous motor which have a direct bearing upon its practical operation are the following:

An ordinary synchronous machine has small starting torque and requires either a heavy starting current or is started by auxiliary apparatus. A considerable amount of switchboard apparatus is required and care must be used in connecting the machine to the circuit.

If there be a sudden increase in the generator speed, a synchronous motor may not be able to increase its speed quickly enough to prevent dropping from synchronism.

The generator speed must be fairly uniform throughout each revolution in order to prevent fluctuation in current and "pumping" of synchronous motors.

If the e. m. f. of the circuit be momentarily lowered (e. g., by connecting a motor to the circuit when it is not in phase, or by overloading a motor and causing it to drop from synchronism, thus producing a heavy current), or if the e. m. f. be cut off the circuit momentarily (e. g., by switching the

circuit from one dynamo to another), the synchronous motor may lose synchronism and stop.

The field strength of the synchronous motor must be adapted to produce an e. m. f. fairly approximating that of the circuit or there may be an excessive current either leading or lagging.

A lagging current produces a greatly increased drop in e. m. f. in generator and transmission circuits. A leading current reduces drop in e. m. f. and neutralizes lagging current. If a synchronous motor and an induction motor be supplied by the same line, the leading current to one may neutralize the lagging current to the other so that the line carries only the current necessary for transmitting energy to the motors.

The synchronous motor must have a wave form fairly approximating that of the circuit to which it is connected or there will be a large idle current flowing.

The e. m. f. of the circuit which operates a number of machines in synchronism is dependent upon the field charges of all the machines; ill adjustment of any of the machines affects the circuit; an accident or carelessness in the attention to any of the machines may disable the whole system.

Each synchronous machine in a system endeavors to impress upon the system its own characteristic e. m. f. and wave form. If the wave form of a large synchronous motor be different from that of the generator, it may alter the resulting wave form on the circuits, which may make it unsuited for other machines which are connected to the circuit.

A synchronous motor which has a bad wave form, an improper field charge, or which is connected to the circuit when out of phase, or which pumps, may affect other motors on the system which are honestly striving to conform to the normal conditions of the circuit, but which become innocent victims of the irregularities of some distant co-worker.

THE EFFECT OF ARMATURE INDUCTANCE UPON THE ELECTROMOTIVE FORCE CURVES OF AN ALTERNATOR.[1]

By W. E. GOLDSBOROUGH.

THE subject of the regulation of alternating dynamo electric machines, considered as a function of the inductance of their armature coils, has been treated by a number of writers, and during the last few years has attracted much attention.

In looking up the bibliography of the subject, the author found that but few records have been published of the actual value of the inductance of the generating coils of these machines, and that even less data are available regarding the real nature of the periodic fluctuations that take place in this quantity.

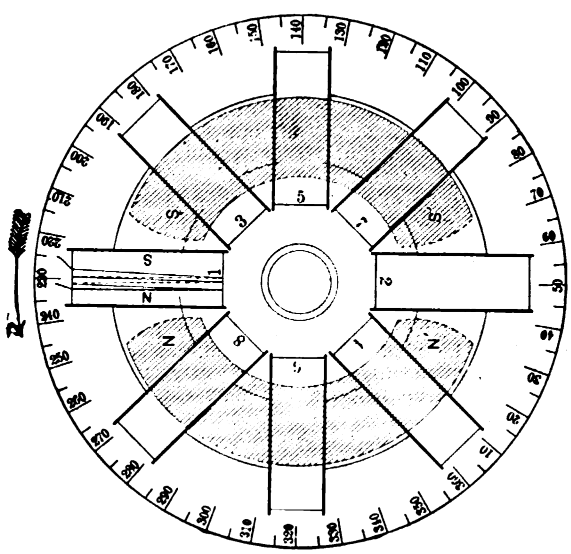


FIG. 1.

Apparatus and Method Employed.—The experiments were made upon a three-light Brush arc machine, fitted with the necessary exploring coils, collector rings and revolving contact-making device. The core of the armature is of the ring type and is built up of laminated iron stampings, held together by laminated iron bands passing around the core between the successive layers of stampings.

The method employed in making determinations of the self-induction of the armature was as follows: An exploring coil of 42 turns of No. 36 B & S copper wire was wound over armature coil 1, and connected in series with the field coils of a high resistance Nalder ballistic galvanometer and an adjustable non-inductive resistance. A constant exciting current of 10 amperes was kept flowing through the field circuit at all times. During the time of taking any one set of readings, a direct current of definite value was maintained in coils 1 and 2, except when the deflections were made.

Armature Inductance.—In determining the coefficient of self-induction coils 1 and 2, coil 1 of the armature was placed at the 230 degs. position, as indicated in Fig. 1, since at this point the magnetizing power of the coils was least, owing to the large magnetic reluctance of the circuit traversed by the lines of force emanating from the coils.

The curves obtained bring to light some very interesting facts. They show that the maximum coefficient of self-induction occurs when the coils are in the 145 degs. position and the current flowing in them has a value of 2.5 amperes; under these conditions their inductance is over .172 henry. They indicate that as the armature current is varied from zero up to its maximum safe value, the inductance of the coils undergoes very marked and relatively rapid changes.

It is also interesting to note that between no load and full load, the crest of the induction curve moves through an angle of 30 degs., or over one-fourth of the width of the pole faces. The large teeth of the armature core do not seem to have the effect of causing any marked irregularities in the inductance curves. It is noticeable, however, that there is a slight hump in all of them at the 90 degs. position. This is caused when the teeth immediately behind the coils pass the pole tips. The same effect is produced by the other teeth, but it is too slight to appreciably affect the readings.

Electromotive Force Curves.—A series of electromotive force curves taken from the machine illustrate the gradual change in the wave form of the effective electromotive force as the load increases. By the effective electromotive force is meant the electromotive force that is in phase with the current and overcomes the ohmic resistance. A curve obtained with zero current in the armature shows that the "fundamental" or internal electromotive force wave of the machine is not symmetrical about the 140 degs. ordinate.

The activity displayed by the eddy currents in heating up the pole tips is quite remarkable. The curves obtained plainly indicate that much greater magnetic disturbances occur in the leading pole tips than at other points in the pole faces.

In the development of the experimental results contained in this paper the dynamo was loaded by inserting sets of incandescent lamps in the external circuit. A special point was made of keeping the external circuit entirely free of any inductance. It is a curious coincidence that the alternating current inductance curves all cross at a common point, namely, at the 164 degs. position.

Counter Electromotive Force Curves.—A set of curves are given showing the cyclic variation of the induction set up in the coils by the armature current obtained by plotting the products of the ordinates of corresponding points on corresponding current and inductance curves. The counter electromotive force curves are highly irregular in form. They oscillate from the positive to the negative value twice in a period instead of once, and are generally useful in filling up gaps. The whole series of inductance curves shows that the curves follow one another in regular order in spite of their lack of symmetry, and it is interesting to note the receding of one and the building up of another "hump" in these curves.

Derivation of Current Curves.—The success attained in working out the counter electromotive force curves led to a series of calculations to determine to what extent the form of the current curves was influenced by the shifting of the phase of the inductance curves with the load. Curves are shown illustrating this effect.

It was noticed during the test that the armature reaction caused an increase in the total effective potential for certain ranges of load.

"LIFTED."

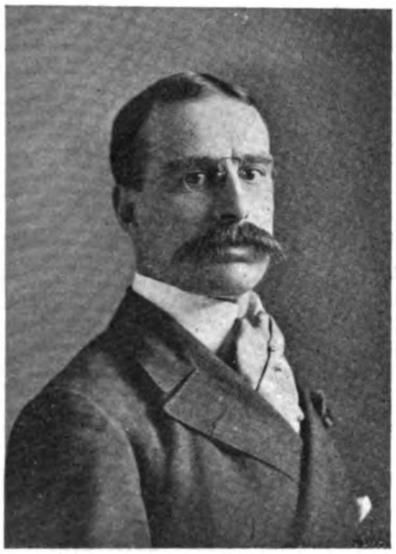
Mr. W. H. Reeves, Jr., of Redwood City, Cal., writes: "Your paper is certainly appreciated in this part of the country, for some one lifted my copy of June 30 before I had even a chance to look at it. Can you send me another, with Data Sheet?"

PROF. W. C. PECKHAM, of Brooklyn, N. Y., writing for back copies of The Electrical Engineer, says: "I find the numbers very valuable, more so than if loaded with equations and bristling with formulas."

[1]Read before the Amer. Inst. of Elec. Engrs., at Greenacre, Me.

TELEPHONY AND TELEGRAPHY

THE STROWGER AUTOMATIC TELEPHONE EXCHANGE, AT AMSTERDAM, N. Y.



William B. Charles.

AMSTERDAM, N. Y., has one of the most modern and complete telephone systems in the country. The plant was built by the Amsterdam Automatic Telephone Company, incorporated in 1896, in which the leading business men of the city are interested, and, although all the wires are overhead, the construction is of the latest type. The officers of the company are Willis Wendell, president; George McClumpha, treasurer, and William B. Charles, secretary, and it was under the direct supervision of the last named gentleman that the system was installed.

Amsterdam is an important center for the manufacture of carpets and other textile fabrics; in proportion to its population, which is about 25,000, more carpet is made there than at any place in the country. It is a most enterprising city, and its citizens were desirous of having first class telephone service at moderate cost. The investors in the Automatic Company have endeavored in every way to meet the necessities of their fellow-citizens, and the following description of the plant will show that they have succeeded. The gentlemen who placed their money in the venture were the first to take up the automatic system on a large scale—before that time the automatic having been used only for interior purposes, or in very small communities. They have invested about $17,000 in the enterprise, and as that sum was spent wholly in the construction of a system for 200 subscribers, it necessarily follows that the plant is of an extremely hign order.

The system of making connections is that of the Strowger Automatic Telephone Exchange, of Chicago, whose system was described and illustrated in our last issue, as installed in Augusta, Ga. The subscriber's apparatus consists of a magneto bell, which also contains the transmitter, below that a box about the size of a Blake transmitter and a battery box underneath. On the face of the box below the generator and transmitter (which contains a switching device) is a plate on which all the numerals appear, commencing with No. 1 at the bottom and extending upward on the right-hand side to No. 0 or X. Corresponding with each number is a notch in which the finger of the subscriber is placed, when wishing to call, and the plate revolved until the stop at the bottom is reached. Upon being released the plate returns to its normal position, and in doing so transmits the signal. This operation is repeated for each figure of the number desired, the calls being made in the order of hundreds, tens and units. After the operation above described is made the subscriber rings the bell, thus securing the attention of his correspondent. By hanging the receiver on the hook, when through talking, the switch is returned to normal. The whole operation is simple.

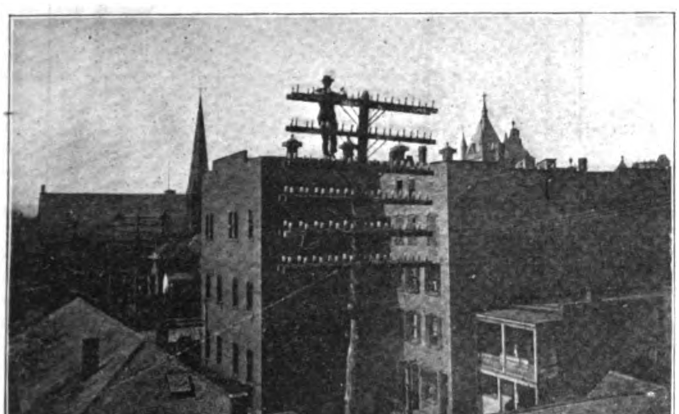
The office of the Automatic Company is at 52 Market street, Amsterdam, N. Y., the front room of the apartment which it occupies being devoted to the general switching apparatus and auxiliary devices. Although the advocates of the automatic system claim that no "central office" is required, there is, nevertheless, a "central," the only difference being that with the ordinary system an attendant is required to make the connections, while with the automatic that work is performed by the subscriber. The Strowger is practically a multiple switchboard; the switch of each subscriber being connected with that of every other subscriber. In the manual multiple board, every subscriber's line terminates in front of each operator in the exchange. In both systems the connections are made direct without the medium of trunk wires between different sections of the board. The Automatic Company's board requires but little space and, to protect it from dust and dampness, it is enclosed in glass. Unfortunately, the position of the board is such that it was quite impossible to secure a photograph of it for the benefit of the readers of this article. Unlike the manual system, the question of light and air is of but little importance in the operations of the automatic system, consequently the company placed its board and battery in a position suitable to its needs. It is most interesting to watch the connections being made, which are going on at all times, Amsterdam being a busy place. One side of the subscriber's circuit calls the hundreds and units, the other side, tens. The first call raises the switching arm (really the plug) up to the notch corresponding with the number of hundreds desired; the second operation turns the arm around to the number of tens, and the third raises it again to the number of units. Instead of seeing the "clearing out" drop fall, as in the manual system, the whole switch falls back to its normal position when released by the subscriber in returning his receiver to the hook.

The switch arm is of the knife blade pattern, which, of course, cleans the points of contact.

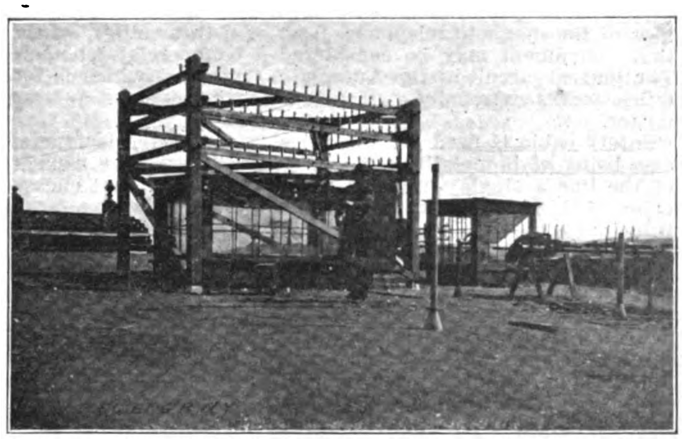
Power for the operation of the switches is supplied by storage battery, the total number of cells being fifty, divided into two sections each of twenty-five, connected in series, one section being charged from the electric light circuit, while the other is in service. An insulated bi-metallic wire, size No. 10 B & S, feeds the whole system.

The telephones used by the company were also manufactured by the Strowger Automatic Telephone Exchange, the transmitters being of the Hunnings type. Until quite recently the transmitter battery has been supplied by dry cells, but it has been deemed advisable to substitute therefor the Leclanché cell.

Amsterdam has no underground ordinance, consequently the Automatic Company built an overhead plant. No expense



LOOKING NORTH ON MARKET STREET FROM COMPANY'S OFFICE.



HOUSETOP FIXTURE ON OFFICE BUILDING.

has been spared, however, to have the outside construction as strong and as durable as possible. Main and Market streets are the busiest thoroughfares of the city and, when the company was formed, both sides of these streets were occupied by pole lines. To secure rights-of-way on these two streets, the Automatic Company entered into an arrangement with the Amsterdam Street Railroad Company and the Electric Light Company, whereby the former rebuilt the lines of the two last named companies on those streets, using 50-foot chestnut poles of standard specifications. The tops of the poles are reserved for fire alarm and police purposes and, in addition to this, the company gives six free telephones to the city. The telephone wires are immediately below the fire alarm wires on 14 pin cross-arms, and still further below, with a considerable gap, are the railway feeders and electric light wires. These poles also furnish the supports for the trolley wires on one side of the streets.

In the outlying districts, 40-foot chestnut poles are used, with 10 pin cross-arms, and in erecting many of these poles much difficulty was encountered owing to solid rock, necessitating blasting of holes. This, of course, added to the cost of construction. All poles are set just within the curb line. The company has 15 miles of pole line, almost all of its wires being carried on its own poles with very few house-top fixtures. It is appropriate to here mention an incident showing the advantage obtained by the Automatic Company through the use of bi-metallic wire. Last winter, the Young Block, on Main street, burned down, causing one of the largest fires ever seen in Amsterdam. The pole line of the company passed this block on the same side of the street. The water thrown on the flames passed through the telephone wires and, as the fire was checked or gained headway, the water on the wires alternately froze or melted. Notwithstanding this and the force with which the water was thrown on the line, not one wire broke and telephonic service was uninterrupted. Nor was it necessary, on the day following, to pull up slack, the bi-metallic remaining taut, although subjected to a severe strain. The longest circuit is four miles, being the connection to Hagamans.

Bi-metallic wire (steel center with copper surrounding it), manufactured by John A. Roeblings Sons' Company, and furnished by the Bi-Metallic Electric Transmission Company, size No. 14 B & S, has been used exclusively in the construction of this plant for subscribers' lines and tapping the general power feeder. The feeder wire is also of bi-metallic, size No. 10 B & S, insulated. This wire has given exceptionally good service from both electrical and mechanical points of view; its great strength has secured to the company uninterrupted service and its electrical qualities have given to the subscribers good talking wires, over which the articulation is clear and the volume of tone is all that is desired.

Not only does bi-metallic wire produce good results when used with battery transmitters, but it also improves the workings of the magneto telephone, used as a transmitter, so that that instrument may be considered a commercial telephone. The longest circuit of the Automatic Company, which is four miles, works extremely well, using the receiver as a transmitter.

Safety cable is used for the office "run in," the conductors also being of bi-metallic. To increase the carrying capacity of the line a single wrap, dry paper insulation, lead encased cable of Roebling make is suspended from the poles on the principal streets.

The company has 200 subscribers, all connected by metallic circuits and gives continuous service. The rates which it has established are extremely low, taking into consideration the quality of service; in fact, they may be called a liveable rate, liveable for both the company and the subscriber, and are $36 a year for business houses and $24 for residences. The cost of maintenance is very low, inasmuch as the company has but one employé, exclusive of officers, who are prominent business men of the city. This employé cares for all the workings of the company, including repairs to line, switching apparatus, telephones and collections, office work, etc. He also builds new lines, and is, in fact, manager, inspector, lineman, accountant, etc., combined. This position has been filled since the company started operations by Mr. C. O. Williamson, who, however, is about to leave in order to install other automatic plants built by the New York State Telephone Company. He will be succeeded by Mr. A. H. Foster.

SHOT FOR CUTTING TELEPHONE WIRE.

A few days ago a telephone wire was cut near Tacubaya, Mexico. The offender has been captured and will be shot, as the Mexican law prescribes that punishment for such offenses.

THE ADER PHOTOGRAPHIC CABLE RECORDER.

In a recent issue we noted the trial made on a new submarine cable-recording instrument, invented by M. Ader, the well known telephone inventor of Paris. Our contemporary, "La Nature," gives further details of this very sensitive instrument. It consists essentially of a very fine metallic wire stretched vertically in a long narrow magnetic field created

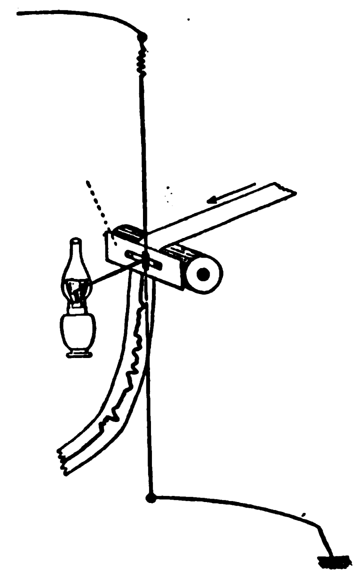


Fig. 1.—Ader Photographic Cable Recorder.

by a strong horizontal magnet, the poles of which surround the wire. The currents coming from the cable pass through this wire, which is driven perpendicularly to the line of the poles to the right or left, according to the direction of the currents.

In order to record the signals produced, M. Ader has devised an arrangement, shown diagrammatically in Fig. 1. Behind the wire and at its center is a plate provided with a horizontal slot. Behind this plate a strip of photographic

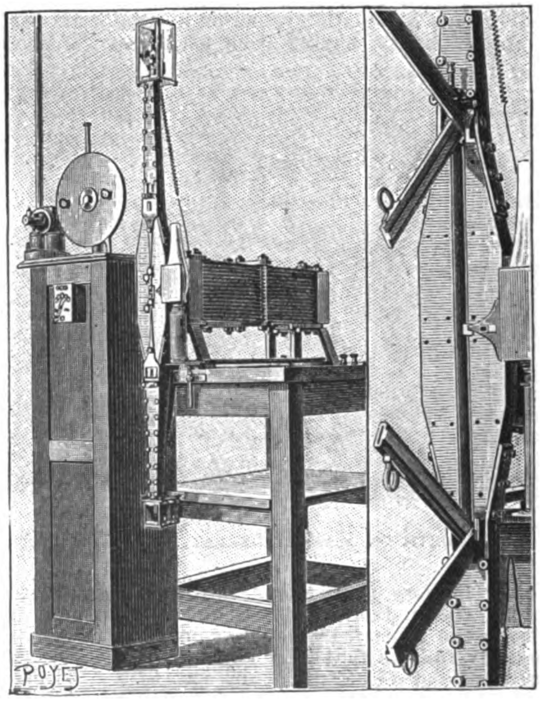


Fig. 2.—Ader Photographic Cable Recorder.

paper is rolled continuously, and in front of it is placed an ordinary oil lamp. The shadow of the wire is projected across the slot on to the paper and traces a line which reproduces exactly the same signals as those of the siphon re-

corder. After exposure to light, the paper strip is automatically developed in three tubes contained in a small, dark cabinet, and the signals formed are traced in white on a black background.

Fig. 2 shows the complete apparatus. The small cabinet to the left is the photographic laboratory. At the top there is an electric motor for driving the paper reel. The movable wire is in the vertical sheath, situated in front of the compound magnet. It can be inspected by opening the pole-pieces of the magnetic field, as shown at the right in Fig. 2. The wire is stretched at the top by means of a small dynamometer spring, with a force varying between two grams and five centigrams. The wire has a diameter of about fifteen-thousandths of a millimetre, and the magnet can carry 400 kilograms. The sensibility of the receiver is such that it gives very fine signals with one Callaud cell, through a resistance of three megohms.

The trials of the Ader apparatus were first made on the P. Q. cables, between St. Pierre, Miquelon, Newfoundland and Brest, France. One hundred and fifty letters a minute were obtained with the same clearness as ninety-five letters, by means of the siphon recorder on the same cable. This was in September, 1896. About two months ago trials were begun on the French government cables between Marseilles and Algiers. Here the siphon recorders work at 150 letters, or thirty words a minute. The Ader recorder worked with the same clearness 350 letters, or seventy words, per minute—that is, a gain of 60 per cent. in the first case and of 230 per cent. in the latter. The system can be worked duplex like any other system. We understand that M. Ader is now at work on a combination, which will permit of duplex working directly without repeating between Paris and New York.

THE EARLY COMMERCIAL DEVELOPMENT OF THE TELEPHOHNE.

WE give below the text of a circular issued just twenty years ago by Messrs. Gardiner G. Hubbard and Thos. A. Watson to push the commercial introduction of the telephone. The data is of a very interesting nature, particularly as it brings out the fact that only private line work was considered; there being not the slightest suggestion of a central exchange or the modern multiple board. It will also be observed that good results are not guaranteed for distances over twenty miles. The instrument "needs no battery." The circular is of four pages, the first being occupied with the announcement quoted below. Two other pages record experiments in Salem and New York, and quote the Award Report of Sir William Thomson, with a superfluous "p" in the middle of his name. The last page gives the opinion of R. C. and F. W. Downer, brokers in Boston, who under date of May 14, say they have had the telephones working between Boston and North Somerville for two weeks, and prefer them to the Morse system.

THE TELEPHONE.

The proprietors of the telephone, the invention of Alexander Graham Bell, for which patents have been issued by the United States and Great Britain, are now prepared to furnish telephones for the transmission of articulate speech through instruments not more than twenty miles apart. Conversation can be easily carried on after slight practice and with the occasional repetition of a word or sentence. On first listening to the telephone, though the sound is perfectly audible, the articulation seems to be indistinct; but after a few trials the ear becomes accustomed to the peculiar sound and finds little difficulty in understanding the words.

The telephone should be set in a quiet place, where there is no noise which would interrupt ordinary conversation.

The advantages of the telephone over the telegraph for local business are:

1. That no skilled operator is required, but direct communication may be had by speech without the intervention of a third person.

2. That the communication is much more rapid, the average number of words transmitted a minute by Morse Sounder being from fifteen to twenty, by telephone from one to two hundred.

3. That no expense is required either for its operation, maintenance or repair. It needs no battery and has no complicated machinery. It is unsurpassed for economy and simplicity.

The terms for leasing two telephones for social purposes connecting a dwelling house with any other building will be $20 a year, for business purposes $40 a year, payable semi-annually in advance, with the cost of expressage from Boston, New York, Cincinnati, Chicago, St. Louis or San Francisco. The instruments will be kept in good working order by the lessors, free of expense, except from injuries resulting from great carelessness.

Several telephones can be placed on the same line at an additional rental of $10 for each instrument; but the use of more than two on the same line where privacy is required is not advised. Any person within ordinary hearing distance can hear the voice calling through the telephone. If a louder call is required one can be furnished for $5.

Telegraph lines will be constructed by the proprietors if desired. The price will vary from $100 to $150 a mile; any good mechanic can construct a line; No. 9 wire costs 8½ cents a pound, 320 pounds to the mile; 34 insulators at 25 cents each; the price of poles and setting varies in every locality; stringing wire $5 per mile; sundries $10 per mile.

Parties leasing the telephones incur no expense beyond the annual rental and the repair of the line wire. On the following pages are extracts from the press and other sources relating to the telephone.

GARDINER G. HUBBARD.

Cambridge, Mass., May, 1877.

For further information and orders address:

THOS A. WATSON, 109 Court street, Boston.

A FINLAND TELEPHONE LOVE STORY.

Mrs. Alec. Tweedie has recently brought out a book entitled "Through Finland in Carts," full of racy chat of travel. She speaks of Finland as being like Norway "riddled with telephones," and tells the following little story to illustrate the excessive use of the telephone by Finnish folk:

"Pekka was madly in love with Ilma, a wondrously beautiful maiden. He heard rumors that she was trifling with another. He could not stand the torture, even for a few hours, and so rang up the mansion of the family Heikkila.

"Joy. He heard the voice if Ilma in answer and said: 'Is it you, dear one ' 'I, Pekka, am here.'

"A soft sigh replied.

" 'Are you glad to hear Pekka? Do you care for him just a little?'

" 'Yes,' sighed the fair maid.

" 'Darling, it is not true you care for Armas Merikanto?'

" 'No, no,' she cried.

" 'You like me—you love me?'

" 'Yes,' she softly murmured.

" 'Will you be my wife?'

" 'I will, Pekka.'

"Overjoyed, Pekka almost hugged the wooden box that brought him such glad tidings.

" 'When may I come to see you, darling—my little wife?'

" 'Come, Pekka, come for dinner at three o'clock.' A few more sweet nothings, and, quite enraptured, Pekka returned to his office routine. At three o'clock, spick and span, with a golden ring in his pocket, he presented himself at the house of the Heikkilas.

"In the salon stood the mother. He went toward her to receive her motherly congratulations. She rushed forward to meet him, as all good mothers-in-law should, and throwing herself into his arms, she cried—

" 'Take me, Pekka, dearest Pekka; I am yours till death.'

" 'Mine!'

" 'Yes. I have loved you long, darling Pekka, and I am ready whenever you can fix a day for our marriage.'

"Tableau. Moral: Beware of Telephones."

As there are, according to Mrs. Tweedie, some thirty-six thousand more women than men in Finland, the action of Pekka's mother-in-law is explainable.

THE NEW TELEPHONE GIRL.

She was a new girl at the Central Telephone Exchange.

Her previous experience in this big and busy world had been behind the counter at Chintz & Chally's.

Nevertheless, she was a pleasant-spoken young lady, and amiability was written all over her nature.

She had adopted as her motto the touching sentence: "We strive to please," and she honestly tried to live up to it.

There was a ring at the bell.

She applied her ear to the instrument, and asked, sweetly: "What number, please?"

"Let me have No. 474."

"I am sorry that No. 474 is busy now," she replied. "You can have No. 473 or No. 475, if you wish."

The individual at the other end of the wire hung up his receiver, and used language which plainly showed that all efforts to please do not necessarily succeed.—Am. Com. Traveler.

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THE SMOKE NUISANCE.

WE are told that about six hundred years ago, when London contained barely 50,000 inhabitants, its citizens petitioned King Edward I. to prohibit the use of "sea coal," and its use was abolished effectively by making its employment a capital offense. The burning of "sea coal" has long since been resumed, and the ancient smoke nuisance is still present to remind us of the persistency of human habit in ancient practices. With the exception of a few horrible examples, such as Pittsburg, Chicago and St. Louis, little was heard of the smoke nuisance, but latterly there has been an increasing demand for a pure atmosphere and the full light of the sun, from quarters where formerly no such complaints were heard, more especially in the East. We are bound to say that personal observation in and about New York appears to warrant fully the indictments which have been brought against the creators of the nuisances complained of. The cropping up of the smoke nuisance in our Eastern cities is, of course, primarily due to the adoption of bituminous coal in place of the anthracite formerly used, and it may be taken for granted that, following a well known economic law, soft coal will continue to be used, and its use will spread as long as the present difference in cost between the two continues to be in favor of the soft coal. The confined area of the anthracite belt and the increased cost of mining it, taken in combination with the constantly increasing area of the bituminous coal beds uncovered leaves little room for doubt on this point. We need only point to the fact that in 1880, the production of coal, in round figures, was, bituminous, 38,000,000 tons; anthracite, 25,000,000 tons. In 1895 the total output of the United States was 172,426,366 long tons; the bituminous output was 120,641,244 tons, while the anthracite production was only 51,785,122 tons. Thus, while within fifteen years the anthracite production has increased twofold, the bituminous coal mined has increased more than threefold. Such being the facts, no surprise need be created by the increasing number of smoky chimneys, even in localities close to the anthracite coal fields. Among these the latest to agitate the subject is the city of Philadelphia, whose Board of Health some time ago called upon the Franklin Institute to co-operate with it in considering ways and means for the abatement of the growing evils of the use of bituminous coal within the city limits. The Institute accepted the invitation and as a preliminary step in its work organized a discussion of the subject in which some of the best authorities in the country took part, and which appears in the last two current numbers of the Institute's Journal. The consensus of opinion of all those who took part in this discussion is, as might have been expected, that smoke can be almost entirely, if not absolutely, prevented by taking suitable precautions. The prime cause of smoke generation being incomplete combustion, it is obvious that by securing proper combustion the desired result can be attained. How to secure this proper combustion was the subject of a variety of recommendations. These all simmer down, of course, to the adoption of a properly constructed boiler furnace, and the proper manipulation of the fuel. The down draft furnace and similar devices and the mechanical stoker were shown to be powerful aids in securing the desired end, but, perhaps, as valuable a suggestion as was made was the reference to the neglect of owners of boilers to provide suitable combustion space when changing over from anthracite to bituminous. As was pointed out by one of the contributors to the discussion, most boiler settings, especially those erected more than four or five years ago, have grates averaging not more than 24 inches below the under side of the boiler shell. This is ample for anthracite burning; but for the combustion of soft coal, which involves two distinct processes, a much greater distance is required in order to prevent the cooling of the hydrocarbon gases against the sides of the comparatively cold boiler, before complete combustion has taken place. By placing the grate not less than 40 inches below the boiler shell, and with careful firing, much of the evil can be overcome. That the mechanical stoker fulfills the almost ideal conditions for burning soft coal was very generally admitted, and as it eliminates the personal equation of the fireman there would seem to be no excuse for a smoky chimney with this remedy at hand.

For those who seek for the prevention of the smoke nuisance by the adoption of oil instead of coal, it may be interesting to know that the limited supply of this fuel in the United States is an effective bar to its general employment for firing purposes, while its present cost, as compared with coal, in the large majority of cases, puts it out of the race.

As regards the legislative steps intended to suppress the smoke nuisance, some advocated a series of graduated fines, but the majority were of the opinion that better and more lasting results could be obtained by educating steam users to a realization that a smoky chimney means loss of fuel and hence just so many dollars and cents out of their pockets. We would like to be of the party of moral suasion, but we are certain that the advocates of this policy have never been domiciled within the noxious area of a soot-belching chimney; if they have they are possessed of more equanimity and charity than falls to the usual lot of man. Vigorous methods have largely prevented the smoke nuisance in St. Louis and Chicago, and soft coal users in other localities would do well to give this matter their attention and to provide voluntarily the smoke-preventing devices which, sooner or later, will be rightfully demanded by the public.

THE TECHNIQUE OF GERRYCIDE.

A PATENT has just been issued to Mr. E. F. Davis on improvements in the apparatus employed for electrocution. It has been generally understood that the apparatus would

stand a great deal of improving, but this seems to be the first patent on the subject. Mr. Davis claims the use of an alternating current machine, whose currents in one direction are stronger than those in the other, and from which therefore a better effect can be obtained in bursting the blood vessels of the criminal in the chair. In addition to this thoughtful arrangement, Mr. Davis has a chair with spring mechanisms attached to it, so that the spasmodic contractions or expansions of the body as the current is thrown on or off can be registered and noted, whether for the muscles of the arm or for any other part of the body. Mr. Davis says that such data has a scientific value, and adds naively that it, "of course, could not be obtained in any other way." The chair also registers the weight of the condemned person sitting in it. Mr. Davis has evidently given the subject his most serious consideration and study, and criminals under sentence of death in New York will be grateful to him not only for the thoroughness with which he enables sentence to be carried out, but for the fact that each case will now furnish scientific data. The patent issued to Mr. Davis is a broad one and well put, but we are under the impression that one or two others exist, in which the expansion of portions of the body of man and the lower animals is registered by closing a circuit and ringing an alarm bell. In a way this would appear to be an anticipation, although the psychological and physiological functions in such phenomena are not readily differentiated in a patent. We shall look for the early publication of some of Mr. Davis' data, showing how high the strapped down criminal jumps in his chair when the disrupting current is let loose on him.

GASOMETERS AS CANNON TARGETS.

WE understand that some very extensive work is to be carried out at Fort Hancock, Sandy Hook, N. J., where thirty-four large buildings will be massed together in formidable defense operations. The area is 250 acres, there will be quarters for 1,000 officers and men, and the emplacements will have fifty guns, 13, 12, 10, 8 and 6-inch. It is evident that such an installation would and should require a large amount of electric light and power, but we are greatly surprised to learn that Gen. Bachellor, U. S. A., who made the plans, has left electricity out of his calculations and that the present specifications call for an illuminating gas plant for indoor and outdoor lighting.

Such a thing must certainly be an oversight or unintentional. It hardly requires one to be an expert in ballistics and fortifications to see that a gasometer is not the most desirable adjunct to a fort exposed as that at Sandy Hook must always be. Not merely is a gasometer a good mark, but the consequences of its explosion, under fire, would be very serious. On the other hand, an electric light plant can be buried, if need be, out of sight as deeply as the powder magazine, and signs of its location would be very hard to discover. Moreover, aside from the value of the electric light on a great many grounds, there are the additional advantages of having a source of current for power purposes. There seems no good reason why a fort should make any less use of electric motors than a battleship, and our men-of-war have won the commendation of foreign experts for their liberal and ingenious equipments of electricity for a wide range of work.

We trust that Fort Hancock when finished will not include a big gasometer as a target for the enemy's guns, but will be furnished with the latest and best electric plant that the money and skill of the Government can buy.

IMPROVEMENTS IN TELEPHONY.

LAST week a fully descriptive article appeared in our pages of a new telephone exchange at Augusta, Ga., where the apparatus is of such a thoroughly automatic type that the "central" office goes on working smoothly even when its doors are locked and there is nobody in it. Commercially considered, this would appear to be a great advance in practical telephony; and the article which we publish this week on a similar exchange at Amsterdam, N. Y., would lead to the conviction that the system is already well within the range of practicability. It is needless to point out the many changes involved in such methods, if generally successful, and finally adopted everywhere, and this evolution will, therefore, be watched with deep interest.

Another feature of novelty, in connection with the telephone exchange at Amsterdam, is the use of bi-metallic wire. The reports of results are very satisfactory, and here again would appear to be an opportunity for getting away from iron wire in telephonic work. It would be difficult to sum up all the damage that has come from the use of the fragile iron wire still so largely in use, and the rapid extension of telephony to-day will only bring with it more accidents and fatalities unless the change is thus made to something of higher conductivity yet better able to stand strains and to resist the effects of time and weather. The indications are that telephone managers constructing aerial circuits are becoming thoroughly alive to the risks they run when using brittle wire; and hence we are likely to see fewer casualties due to broken wires and crossed trolley, lighting and telephone circuits.

PROVE ALL THINGS.

THE X-ray has come into use as an invaluable aid in carrying out the Scriptural injunction to prove all things. It was early suggested to try the ray on mummies, and this has since been done with gratifying results, so that it is no longer necessary to carve up specimens of preserved humanity to see if there is anything inside. The application of the same plan or principle to odd and abnormal beings, or freaks of creation, such as find their way into museums and shows of the Barnum type, is obviously useful and practical. It is said that a Japanese monster brought recently to the Salpetriere Hospital, in Paris, was submitted to the ray. It purported to be the carcass of a mermaid, but it was shown to be without bones and therefore a built-up fraud, very cleverly done. The missing link had, however, too many links missing, and the fishy creature was altogether too fishy. The modern shibboleth of scepticism is, "Ray all things."

WOMEN IN TELEPHONE EXCHANGES.

AT one time there was a very decided prejudice against the employment of women as night operators in telephone exchanges, but it is certainly disappearing. An instance of this is given by the New England Telephone Company, which has just discharged some thirty men who had been doing night work in Boston, and has returned to the use of young women for the hours of night duty. We are glad to see the change made, and believe that the objections to it are far more visionary than real. The electric light, the trolley car and the police signal system have made the streets of our modern cities generally safe at any hour of the night for ordinary passengers, even on foot; and the field for the employment of women has thus been distinctly widened by the introduction of the electrical arts.

WIRELESS telegraphy is occupying a good deal of attention just now, and to accompany the encouraging reports from Mr. Tesla of his advances and success with new apparatus for such work, we note the statement from Marconi that he is about to signal electrically without wires from St. Paul's Cathedral, London, to the Eiffel Tower, in Paris, a distance as the crow flies of perhaps 150 to 200 miles. It will be interesting to see what comes of all this movement which may well betoken a new advance in electrical discovery and invention.

News and Notes

SOME NEW PRINCIPLES IN DYNAMO DESIGN.

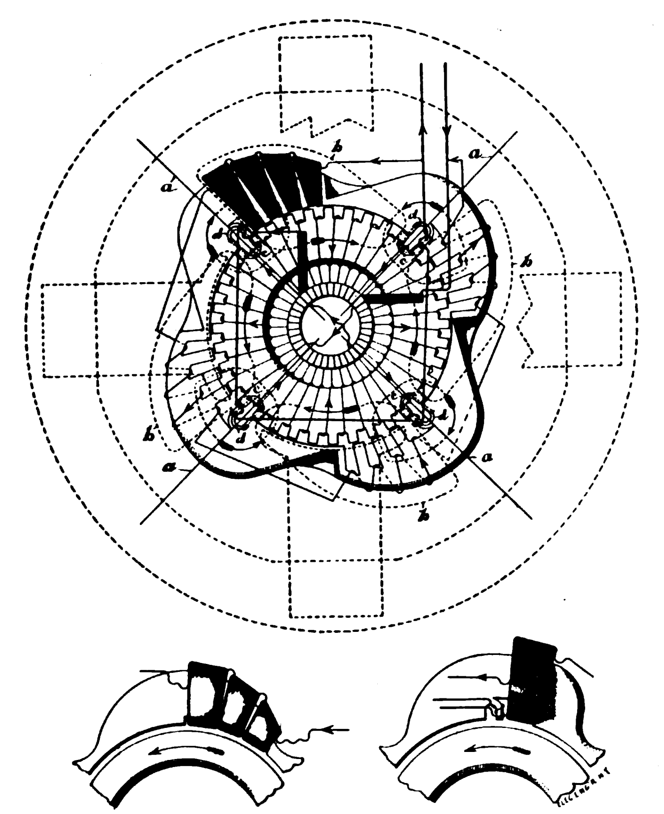
BY ALBERT W. SMITH.

IN the present types of dynamo the field distortion, due to armature reaction, is combatted by the employment either of a large air gap, or oversaturation of the core teeth, or both; the object being to oppose as much reluctance as possible to the magneto motive forces of the armature, and thus resist or limit field distortion due thereto. Unfortunately, however, the reluctance obtained by these means is equally opposed to both the armature and field windings.

These methods, therefore, necessitate the employment of large field coils, which impose the necessity of long magnet cores, which in turn imposes a large and heavy ring or yoke structure.

In spite of the large air gap reluctance, more or less field distortion, according to load, takes place, thus necessitating a forward shifting of the brushes, which, in turn, destroys the balance between the front and back armature turns interlinking with the field flux, thus proportionately weakening the field magnetism, and therefore imposing the necessity of using series or compounding coils, which still further increases the length of the magnet cores, and the amount of magnetizing energy, etc.

All of the above named conditions, therefore, conspire to impose the necessity of using a field magnet structure which is several times heavier than the armature, and which requires a large amount of magnetizing energy, and adds enormously to the weight of the machine per unit of output.



THE SMITH IMPROVED FIELD MAGNET WINDING.

To overcome the above named untoward conditions, it is proposed to displace the field magnet coils rearwardly from the neutral or commutating points, and to wind them in or across the flux paths of their respective magnets, and close to the armature, as shown in the accompanying illustrations.

Argument.—It is obvious that the magnetism generated by any given turn or section of a field coil must pass through that turn or section, though it need not necessarily pass through all of the turns or sections of the coil, but may leak out through the side of the coil adjacent to its own turn or section; it follows, therefore, that the magnetism generated by a field coil cannot be shifted forward further than the width of the coil.

It is then only necessary to wind the coils entirely back of the neutral lines, a a, and as close to the armature as practicable, to insure the desired freedom from field distortion; this is made possible by using a field magnet structure which has on one side of its neutral points a single wide pole, or polar area, and on the other side thereof a plurality of smaller poles, forming between them coil-containing spaces (or instead of plural poles a single large coil space), in which space or spaces the coils are wound, as shown in accompanying diagrams.

By this method of winding the field coils, a long external air path of very great reluctance is opposed to the armature magneto-motive forces, b b, thus obviating the present necessity for a large air gap reluctance; the size of the air gap is, therefore, imposed entirely by mechanical conditions, and can be made very small, while the core teeth can also have the same low reluctance as other parts of the magnetic circuit. The magnets, consequently, requiring only a small fraction of the magnetizing energy now necessary, and the coils being correspondingly smaller, consequently require proportionately less winding space; thus insuring a field magnet structure which has about the same weight as the armature, or somewhat less. The dotted outline shows in contrast the ordinary form of field structure, consisting of cast iron yoke ring with wrought iron cores cast in.

The present method of commutating under the leading pole corners is defective, because the brushes cannot remain in a fixed position, without sacrificing other desirable qualities, and also because it imposes the use of carbon brushes, which cause a considerable waste of energy.

To obviate these defects, it is proposed to entirely prevent the spark causing self-induction, due to the rise or increase of current in the armature coils at the moment when their segments leave the brushes. This is accomplished by interlinking the coils at the moment when their segments leave the brushes—and when tending to produce self-induction causing magneto-motive forces, due to current increase, as represented by arrows, c c,—with counter magneto-motive forces represented by arrows, d d, which, being equal or superior to them in strength, suppress those due to the armature coils, and thus absolutely prevent the existence of any spark causing self-induction in the commutable coils; thus insuring sparkless commutation, and enabling the use of metal brushes, which may be either solid, laminated or of gauze construction, and which remain in a fixed position for all variations of load and speed.

With this method of commutation the coil does not cut a magnetic field at the moment when its segment leaves the brush, as it does in the present used method; the electro-motive force due to self-induction is, therefore, not neutralized or counteracted by an opposing electromotive force, due to the cutting of a field, but is absolutely prevented from coming into existence, by interlinkage of the coil with a field of contrary direction to that which the armature coils tend to set up at the moment when the segment breaks contact with the brush. It will be apparent that the conditions and results obtained with this method of commutation are analogous and equivalent to those which prevail in motor generators having both windings on the same armature. In this type of machine, as is well known, the brushes remain fixed for all conditions of load, and commutation is sparkless and perfect. The absence of field distortion and sparking makes it possible to arbitrarily locate the position of the brushes when designing a machine for any given service, thus enabling any kind or amount of automatic regulation to be obtained by simply determining or fixing the constant ratio or proportion between the front and back armature turns interlinking with the field flux; thus enabling a machine to compensate for drop in engine speed, to have a rising voltage, as for railway work, or to have a falling voltage, as for some kinds of electrolytic work, without the use of any series or compounding coils.

With the present types of dynamo the output of the machine is limited by the current carrying capacity of the armature, and by the sparking at the brushes. The carrying capacity, and, therefore, the output of most armatures in present use, could be greatly increased by a better design of winding, eliminating spiral end connections, etc.

This has not been generally done, for the reason that the present low sparking limit would permit of no material increase in output; the absence, however, of both field distortion and sparking in the present design makes it possible to take full and complete advantage of all available means for increasing the carrying capacity of the armature, and, therefore, makes possible a proportionately greater output or effectiveness from a given size of armature.

The absence of field distortion and sparking also makes it possible to design high voltage direct current machines for power transmission over long distances, thus securing higher efficiency, especially at part load, and lower first cost than is possible with the present used methods.

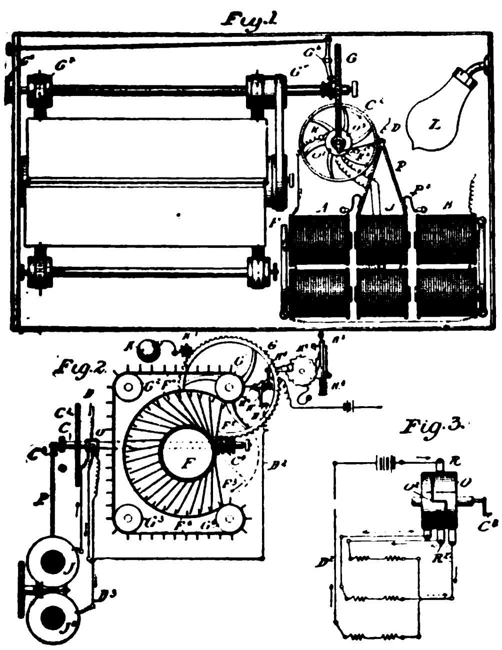
It is sometimes desirable to directly connect dynamos to high speed steam turbines, thus obtaining large output, due to high velocity. While it is possible to do this with dynamos of the present type, much difficulty is experienced, due to the inherent defects of field distortion, and self-induction in the armature coils, all the bad effects of which are greatly aggravated under those conditions, and, therefore, tend to impose a kind of speed limit on the armature.

In the design here proposed, however, this speed limit does not exist, and in so far as difficulty from these sources is concerned, the armature can be run up close to the mechanical or bursting limit, thus making it possible to obtain under these conditions a very large output per unit of weight and also very high electrical efficiency.

COMBINED ANNUNCIATOR AND ADVERTISING CABINET FOR CARS.

MR. GEORGE H. PUGH and Dr. J. P. Orr, of Pittsburg, Pa., have recently designed an apparatus designed to be placed in cars and combining the functions of a street annunciator with an advertising cabinet.

The accompanying illustrations show plan and sectional views of the mechanism, comprising a cylinder, F, having mounted thereon leaves or cards on one side of which is the name of a street or station and on the other side of which is displayed a business card or other advertisement. These cards are controlled by a toothed belt mounted on pulleys G, which have gear connection with and are propelled by an electric motor comprising six helices, four of which are



COMBINED STREET INDICATOR AND ADVERTISING CABINET.

mounted in pairs with space between, and two helices pivotally mounted between the pairs as an electro-magnetic armature, electrically connected with commutator O, which has two peripheral rings with offset portions insulated from each other. These rings in contact with the brushes are connected with the helices of the armature, and the offset portions are in contact with brushes, thus completing circuit through the magnet helices and battery, as shown. The reversed current through the armature, is shown by dotted arrows.

The device is set in motion by an ordinary push button or by a bell rope connection, and stops automatically as soon as a leaf or card swings downward to display the "next stop."

PEORIA, ILL.—Mr. A. N. Morton, local freight agent of the C., P. & St. L. Railroad, is seeking to secure a franchise for an independent telephone company, which eventually should have 4,000 instruments in use.

LETTERS TO THE EDITOR

INTERIOR CONDUIT AND THE FIRE RISK.

IN your issue of July 22 is an article on "The Inconsistency of Plain Iron Interior Conduits," by "Jim Crow.". The writer evidently does not properly conceive the function of iron pipe or iron-armored conduit as viewed from the standpoint of one who has the prevention of fire in mind. High insulation is not necessarily a protection against fire. I have known of lightning discharges breaking through good rubber-covered wire, and a considerable distance of air gap, starting short circuits which caused fire.

An iron-armored or iron conduit, if properly put up, is a protection against fire, even if a short circuit between the wires within the pipe, or a ground on the pipe occurs. The chief difficulty lies in getting contractors to put up this class of work properly. The piping must be electrically continuous and heavily grounded, with a ground of carrying capacity equal to that of the largest wire in the system. All couplings must be tight, and all joints electrically as well as mechanically secure. A single ground occurring in such a system is immediately indicated on the ground detector, and grounds on opposite sides of the line blow the first fuse on the line or lines in trouble. No ground can occur except on the piping system; in short, the armor-conduit stands guard to protect everything else from the wires and the wires from everything else.

Whether plain iron pipes or insulated pipe should be used has been wisely left to the individual engineer to decide, the additional insulation being required either on the wire or in the tube. If it is placed in the tube, we have a reasonable assurance that the tube is smooth on the inside. On the other hand, in pulling a conductor into a tube the strain and abrasion is greatest at the bends. This strain is on a different portion of the wire each instant, but always on the same portion of the tube. Hence, the additional braid should be on the wire. The advantages and disadvantages of placing the insulation in one place or the other thus seem to balance one another. Manufacturers of wire or of conduit should not be allowed to influence the decisions of inspection bureaus, the fairness of whose attitude is demonstrated by the acceptance of both systems.

Where no secure electrical, mechanical or magnetic protector stands guard over the wires, large air spaces and high grade insulators are necessary and are properly insisted on. The main dangers arising from electric wires are due to ignorance or negligence on the part of wiremen more frequently than to defects in the rules. With iron conduit, as with all other systems, slovenly work, poor joints and bad insulation make a dangerous equipment.

WM. MAYO VENABLE,
Inspector Cincinnati Underwriters' Association.
Cincinnati, Ohio.

THE GIANT SEE-SAW.

Noticing that on page 66 of your issue of July 22 you describe and illustrate the Nashville Exposition "See-Saw," mentioning it as unique and newly designed, I beg to call your attention to the fact that I designed an analogous structure. of much larger size, in the year 1891, submitting drawings of the same to the managers of the Chicago Exposition, as a possible structure of interest. It was, however, not built, on account of the large expense involved.

This structure was illustrated at the time in a number of newspapers, notably among them the Scientific American Supplement of May 30, 1891. OBERLIN SMITH.

Bridgeton, N. J., July 28, 1897.

BUTTER MADE ON A STREET CAR.

The dame owners of cows in the vicinity of the packing houses, when the cream is ripe, set the churn on the front end of a car. One round trip and "churnin's done," the motorman taking the buttermilk as an equivalent for the mechanical agitation imparted.—Wichita Eagle, Kansas.

ELECTRIC TRANSPORTATION

THE PYOTT ELECTRIC STREET CAR.

MUCH ingenuity has been displayed in the designing of street railway cars, resulting in making the American car the model for the rest of the world. Yet we are constantly brought face to face with still further improvements, effecting increased capacity and ease for handling passengers and

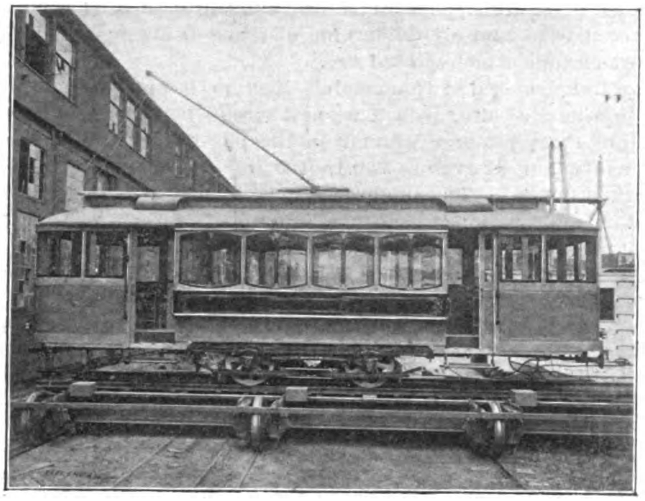


Fig. 1.—Pyott Street Car.

at the same time adding to the comfort of riding. A novel departure embodying a number of striking features in street car building has recently been made by Mr. Louis T. Pyott, of Philadelphia, to whom a number of patents have been issued both on car body and on truck construction. The accompanying illustration, Fig. 1, shows the Pyott car complete on a transfer table, at the works of the Harlan & Hollingsworth Company, of Wilmington, Del., the builders.

The dimensions of the car are as follows:

	Ft.	In.
Extreme length of car over bumpers	33	0
Body length	31	8
Distance between doors	14	6
Body width in center	8	0
Body width in ends	7	0
Spring base	13	0
Wheel base	6	6

The car is equipped with the new "General Electric, 1,000," motor.

A distinguishing feature of the car is the truck, which is shown complete in Fig. 2, and which has been designated as the "companion," or "sectional truck." As will be seen, each pair of wheels and axles has its own independent "horseshoe" frame pivoted and connected with the other, thus permitting each pair of wheels to independently follow the rails in any elevation or depression, without any possible twisting of the framework, or the unseating or heating of the journal bearings, or the rubbing of the axle boxes on the pedestals, thereby reducing the running friction and the twisting of the supported car body to a minimum, and the motor and its supports are in perfect alignment with the same. Fig. 3 shows an enlarged view of one of the "companion" truck frames.

The auxiliary frame or structure beneath the car is evidently adapted particularly to the varying conditions of the

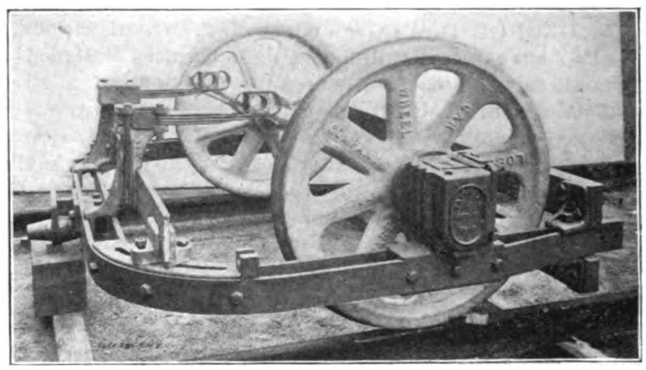


Fig. 3.—One Section of Pyott "Companion" Truck.

cars to be carried, as shown in the fact that in the car illustrated the length of the spring base is 13 feet.

The beam above affords a point of bearing under which is supported a single equalizing beam in connection with the springs, bearing directly on the oil boxes. There is thus secured what steam railroad men term a three-legged support for the car in relation to the rail, avoiding the twisting and

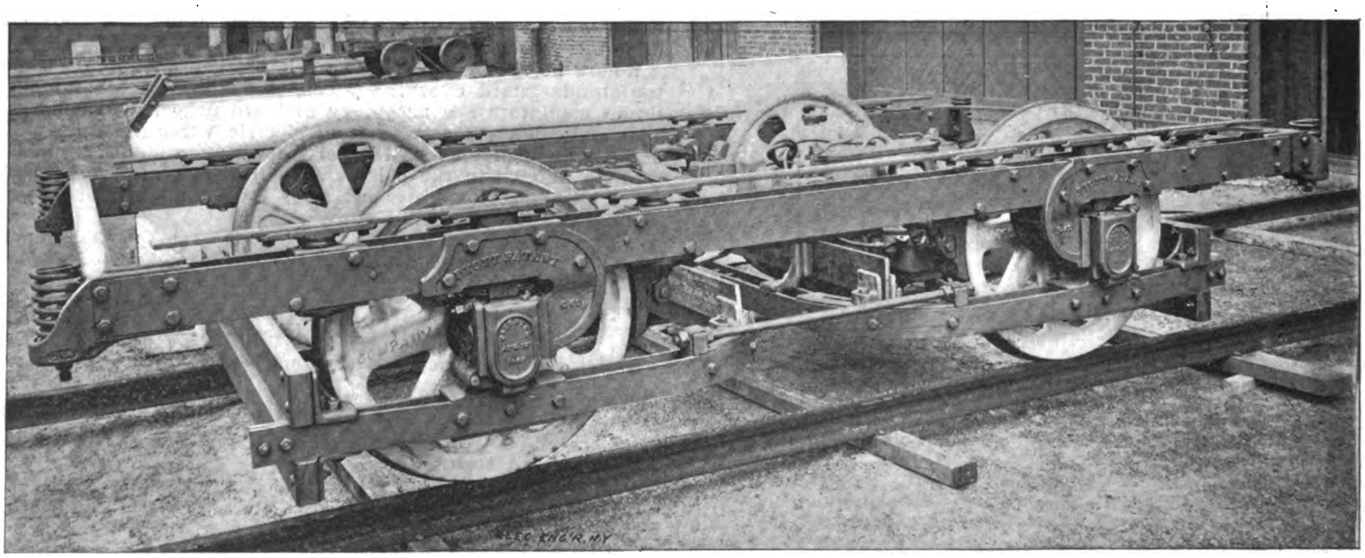


Fig. 2.—Pyott "Companion" Electric Street Car Truck

rocking of the car body usual in four supports, where some one of the four is usually too high or too low. The equalizing beam allows the wheels to move up and down to any irregular alignment of the rails, and when the springs admit of no more action under an excessive load, there is a mechanical action in the lever or beam device itself.

The motor support is at the usual point of a side bar or balance support. An arm spring is in direct connection with the motor casing, dispensing with the usual combination of levers, links and coil springs.

A single-legged pedestal is employed to combine the lower section of the truck and auxiliary frame under the car, thus admitting of the use of a side gap oil box which permits of easy removal of the axles and allows a thorough examination

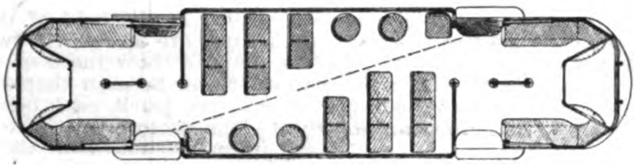


FIG. 4.—SEATING ARRANGEMENT OF PYOTT STREET CAR.

of the condition of the journals to be made in a few minutes. The brake is center hung and very powerful in its action.

Mr. Pyott has given particular attention to the seating arrangements in the car, which has a seating capacity of 38

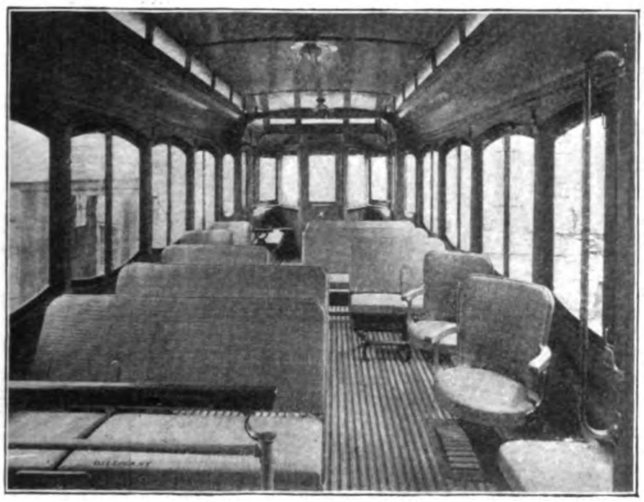


FIG. 5.—INTERIOR VIEW OF PYOTT STREET CAR.

persons, with ample room to carry 100 in all. The layout of the car body is shown in the diagram, Fig. 4, and Fig. 5 gives an interior view of the car. In this method of building a car the usual platforms are entirely dispensed with.

As will be noted the car has two doors on each side, placed about midway between the center of the car and the end. This lessens the amount of travel required on entering or leaving the car, and hence effects a saving in time. The diagonal aisle through the central portion of the body brings a direct line of exit to the rear right-hand door, which is immediately under the eye of the conductor. When running on a single track road all four doors can be used. By dropping the lever or cross-bar at the door the step is raised and the use of the door opening dispensed with, thus rendering it safe when running on a double track road.

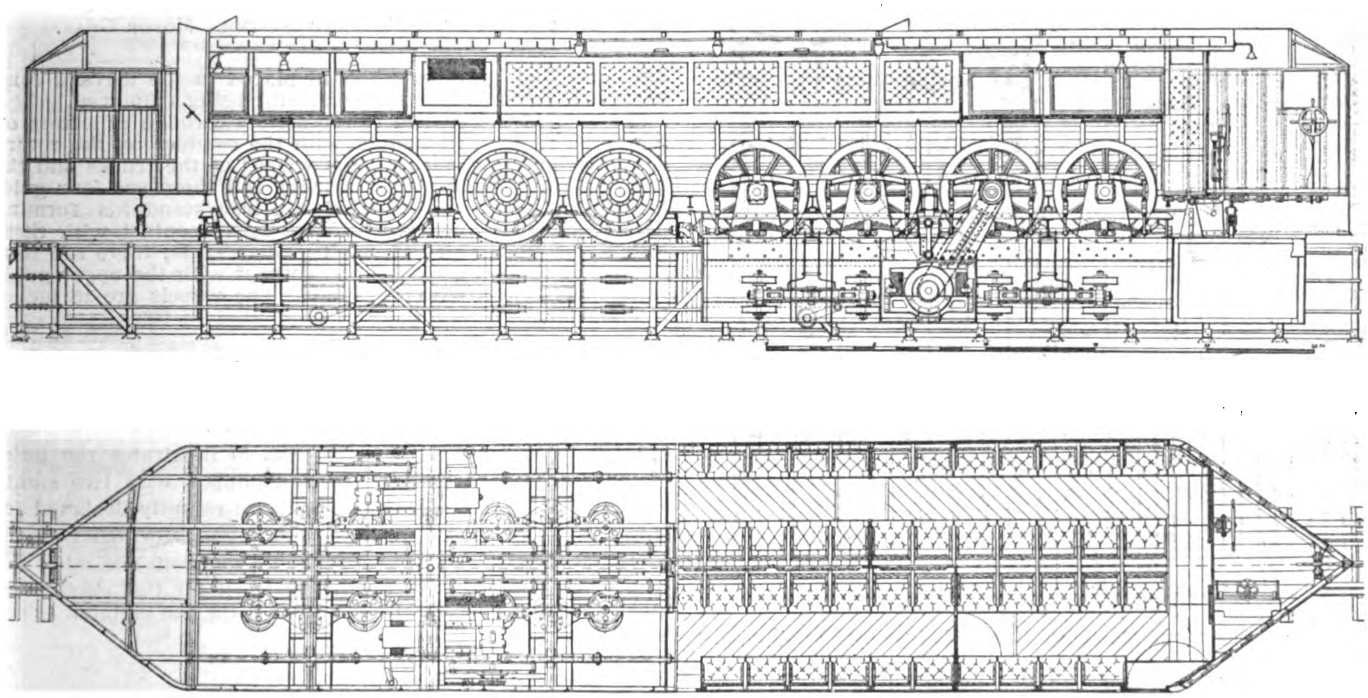
The car is intended for universal use the year round, having movable sashes carried in pockets provided in the car, readily removed and stored in the car, in warm or pleasant weather, and readily removed from their storage place and applied to make a closed car if a storm arises, or in cold weather. The motorman's compartment is arranged to close in rough weather.

From the above description it will be apparent that Mr. Pyott has embodied in his car a number of principles eminently calculated to afford ease and comfort for passengers, and economy for the railway management, as an equipment of these cars answers every purpose of the double equipment of closed and open cars now generally in use.

THE BEHR MONORAIL ELECTRIC RAILWAY.

THERE appears to be a particular fascination among railway engineers of a speculative turn of mind for a single rail system. The latest serious attempt to realize such a system and to solve the problem of very high speed transportation is embodied in the Behr monorail system now in operation in connection with the Brussels Exhibition. The Behr car and track system are shown in the accompanying engravings, taken from "Engineering."

The car is 58 feet long and about 11 feet wide. It is framed entirely of steel. Its bottom edge is 7 inches clear of the sleepers, and the floor level is about 5 feet above, the height of the bearing rail from the sleepers being 4 feet 1½ inches. From the floor or upper deck of the carriage the sides rise so as to give a lofty enclosure for the passengers, and the roof is arched, as shown in the cross-section, Fig. 3. The same figure indicates the transverse form of the carriage, which is made with a deep recess running for its whole length to receive the wheels and trucks on which it is carried. The driving and guiding mechanism is contained in the hold of the carriage, the electric motors being attached to the framing of the lower deck. As is shown in the plan, Fig. 2, the ends of the vehicle are tapered to an edge to reduce the air resist-



FIGS. 1 AND 2.—THE BEHR ELECTRIC HIGH SPEED MONORAIL CAR.—LONGITUDINAL SECTION AND PLAN.

ance when running at high speeds. The capacity of the carriage is 100 passengers, for whom seats are provided in four rows, each passenger being provided with a separate seat,

specially shaped to reduce, as far as possible, the unpleasant effect of centrifugal force when passing over sharp curves at high speed. Internally the carriage is divided into compartments, one of which, 20 feet long by 5 feet 6 inches wide, is reserved for the use of royalty.

The weight of the car is about 55 tons, which is considerably in excess of the designer's intention, the weight originally proposed having been 47 tons. As will be seen from Fig. 3, the roof of the carriage is double, the distance between the outer and inner casings being sufficient to admit of a device for supplying air to the interior of the carriage, without any violent draught. Ventilators are placed on the roof, and air flows through them into the space between the casings, where it is met by a series of baffle plates, that gradually reduce the velocity of the current, until it flows through openings in the inner casing, at a convenient rate. As will be seen from the longitudinal section, Fig. 1, the carriage is lighted by incandescent lamps, taking their current from the main circuit. The triangular chamber in the bow of the carriage is reserved for the driver, who has at his command various devices for controlling the current, manipulating the special air-brakes, and putting on the hand-brakes for bringing the carriage to rest.

One of the original features of the Behr carriage is the arrangement adopted for checking the carriage when running at a higher speed than could be controlled by existing forms of brakes. For this purpose the tapering ends forming the bow of the carriage, are fitted for their whole height with a series of louvre plates turning on vertical spindles, the lower ends of which are extended beneath the floor and carry worm-wheels that gear into a series of worms on a horizontal shaft. These are shown in the longitudinal section, as well as the hand-wheel and bevel gear turning the shaft. By operating this wheel all the louvre boards on each side of the bow are opened more or less at the will of the driver, and air resistances are created by the exposure of the inner sides of the louvres and the side plates of the frame. It is intended that as soon as the speed is reduced to convenient limits by this means, that the stop should be completed by means of the

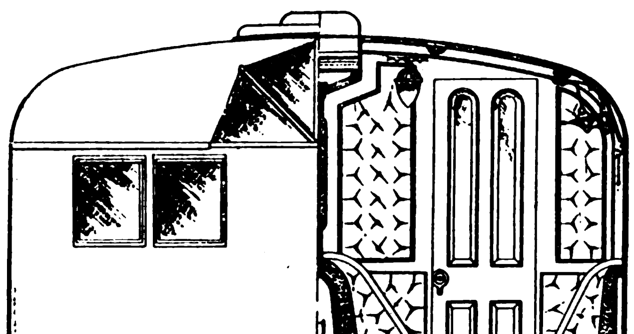


Fig. 3.—The Behr Monorail Car.—Transverse Section.

hand-brakes, which can be applied to each wheel of the carriage; the position and method of hanging these brakes is indicated in the longitudinal section, Fig. 1.

The carriage is supported by eight wheels, 4 feet 6 inches in diameter, mounted in two four-wheeled trucks which are coupled at the center by means of a universal joint. The very short axles of the wheels run in boxes mounted on pedestals that are riveted to the main frame, and the carriage is hung on the boxes by means of cast steel curved hangers to springs, one on each side of the wheels, the springs being beneath the axles. The general arrangement is shown in the section and plan, Figs. 2 and 3.

There are four electric motors, placed in the hold of the carriage. Thus two wheels of each truck are driven, the two outer wheels running free. Figs. 2 and 3 show the disposition clearly, and from these figures it will be seen that the motors are placed on opposite sides of the truck, each being coupled to an independent wheel. The motors are of the four-pole type, with toothed armatures wound with Eickmeyer coils. Each motor is designed for developing 150 h. p., when furnished with a 700-volt current and running at a speed of 600 revolutions per minute. As will be seen, the motors are bolted to the lower deck of the carriage, and a rigid distance-piece, Fig. 4, connects the motor shaft with the axle of the driven wheel, the speeds of each being equal. The means of transmission is a Renold steel chain, which appears to have given satisfactory results when tested. The motors

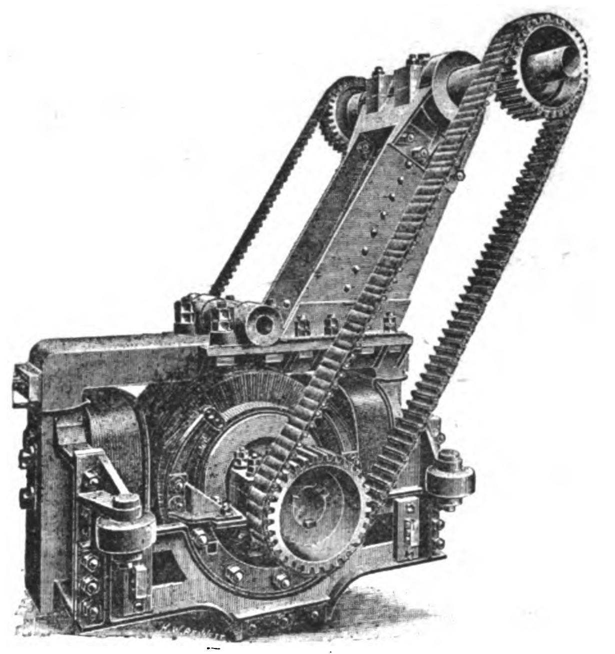


Fig. 4.—The Behr Monorail System. Motor Gear.

are controlled by a switchboard placed in the driver's compartment, the multiple series control being employed.

The current is supplied to the motors through collectors on the carriage, kept in contact with the conductors, the return circuit being made through the wheels of the trucks and the carrying rail. Besides this carrying rail there are four guiding rails, two on each side of the iron standards forming part of the permanent way. Working in contact with these rails are sixteen pairs of small guide wheels; there are thus sixteen of these wheels kept in contact with the upper guide rails, and sixteen with the lower. The wheels are 18 inches in diameter.

ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.—II.

BY PROF. S. H. SHORT.

THE accompanying diagram (Fig. 5) illustrates the Baldwin standard elevated truck equipped with two standard 200 h. p. L motors, which we have recently designed for this work. These will operate a standard elevated train of three cars, fully loaded, at a schedule speed of 16½ miles per hour. We give also the train data sheet for this equipment, and speed and horizontal effort curves for the motors. (Figs. 6 and 7.)

TRAIN No. 1.

Elevated Railway Service:

Number of cars in train	3
Full speed of train on level track (miles per hour).	31
Ave. speed, stops ⅓ mile apart (miles per hour)....	16.5

Motor Car.

Weight of motor car body ....tons	10
Weight of both trucks ....tons	10

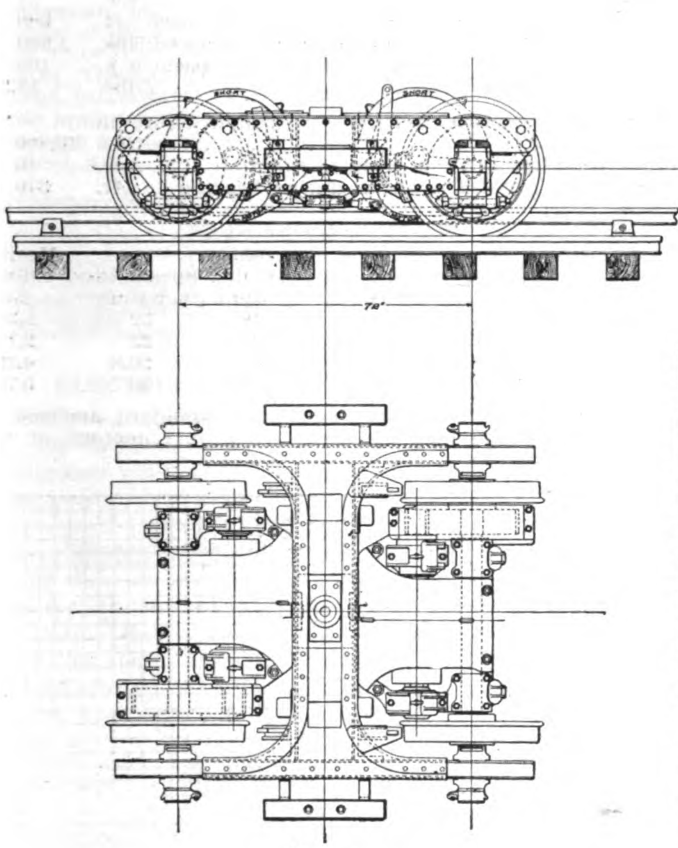
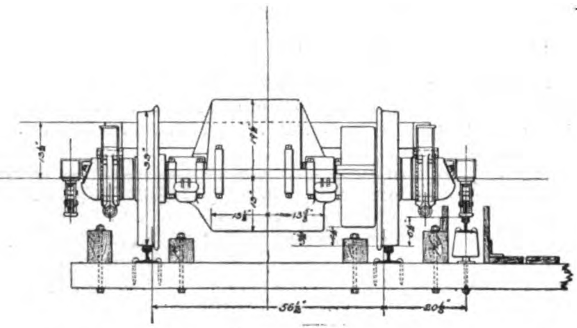


FIG. 5.



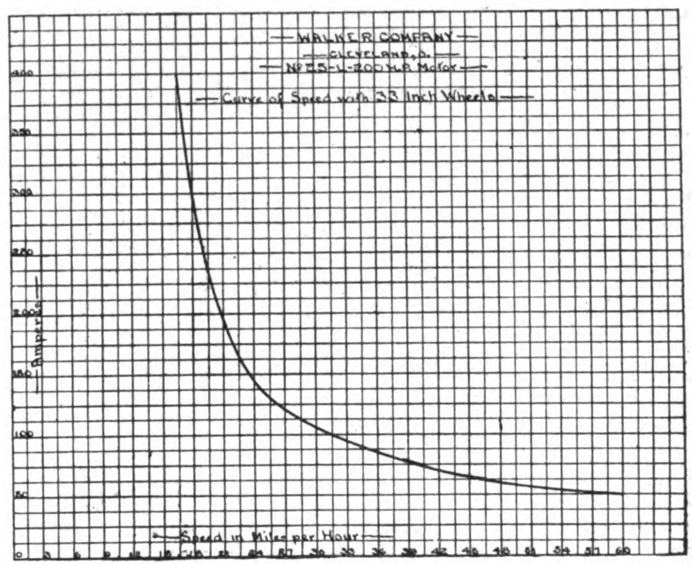
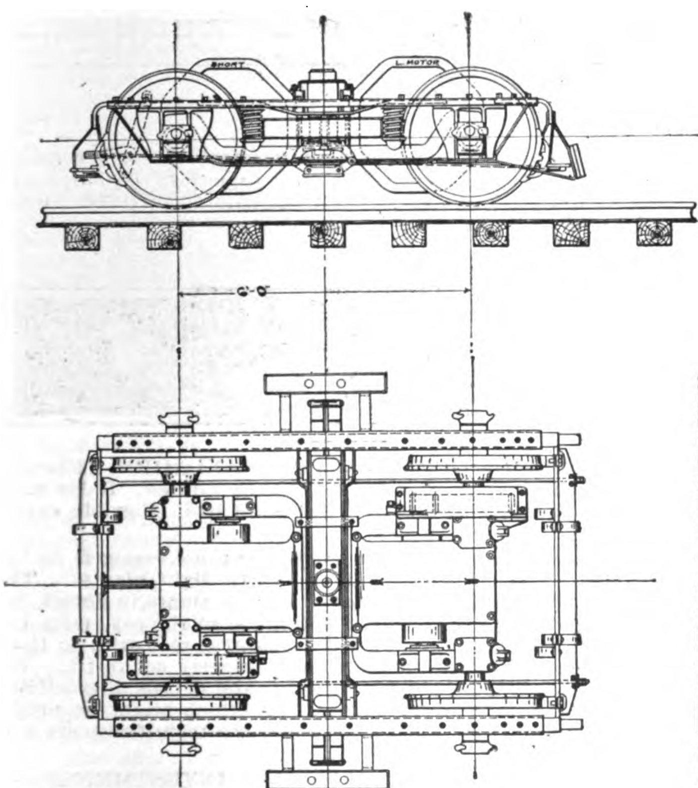


FIG. 6.



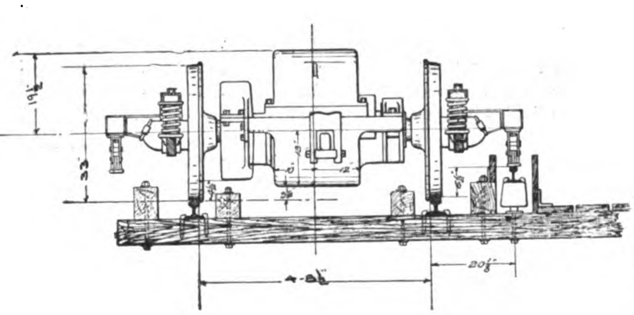


FIG. 8.

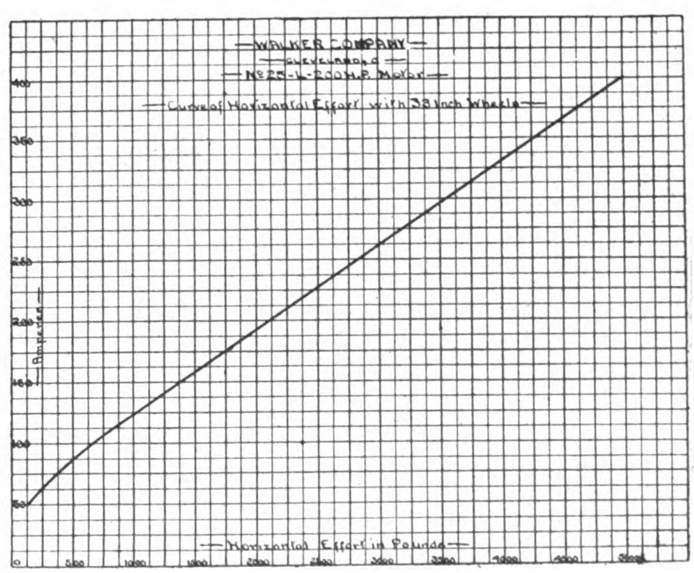


FIG. 7.

Weight of two motors ....tons	7
Weight of seventy-five passengers ....tons	5
Total weight of loaded motor car..........tons	32
Number of motors on motor car	2
Commercial rated power of each..................	vertiio
Safe constant load for each ....h. p.	100

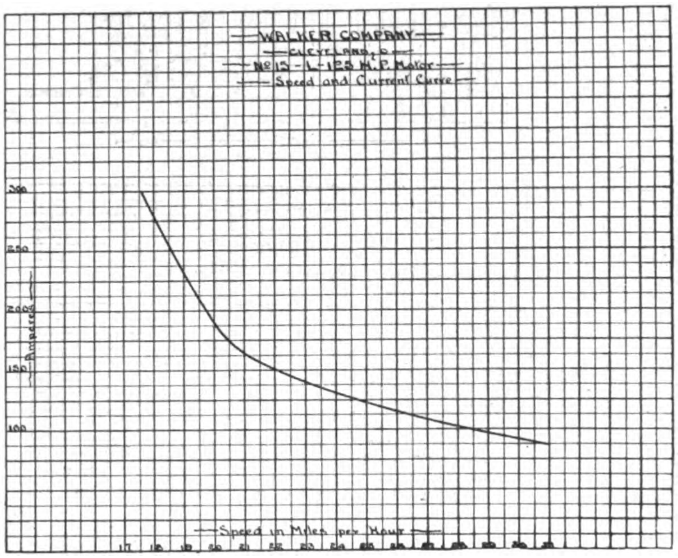


Fig. 9.

Safe temporary tractive effort equipment......lbs.	10,000
Safe constant tractive effort of equipment......lbs.	3,500
Weight on drivers ....tons	19.5
Ratio of weight on drivers to total weight.........	26%
Adhesive power ....lbs.	9,750
Ratio of safe temporary tractive effort to adhesion.	100%
Ratio of safe constant tractive effort to adhesion...	36%

Complete Train.

Total weight of loaded motor car ....tons	32
Weight of two coaches ....tons	32
Weight of 150 passengers in coaches.........tons	10
Total weight of loaded train ....tons	74

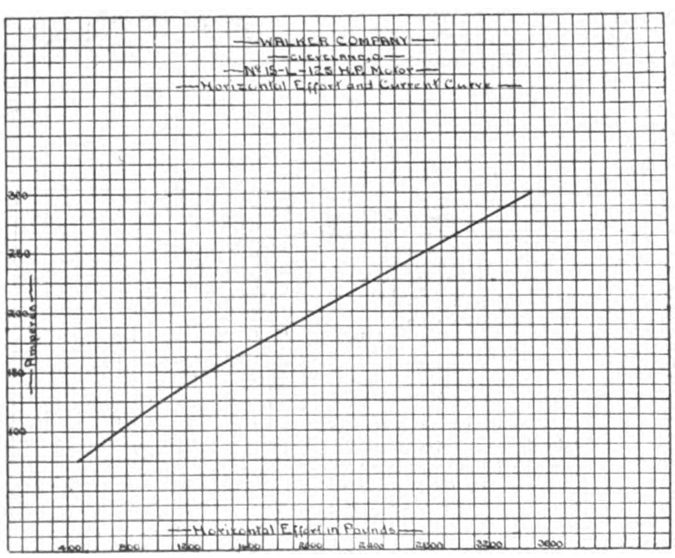


Fig. 10.

Maximum horizontal effort in accelerating train.lbs.	9,750
Horizontal effort per ton during acceleration...lbs.	132
Maximum power in accelerating uniformly to full speed ....h. p.	412
Maximum current at 500 volts accelerating train uniformly to full speed ....amp.	780
Time required in accelerating uniformly to full speed ....sec.	34
Distance in which train will acquire full speed...ft.	900
Horizontal effort, train running uniform speed..lbs.	1,300
Power consumed, train running uniform speed.h. p.	106
Tractive effort per ton ....lbs.	18.25
Maximum practical negative horizontal effort in braking ....lbs.	13,800
Time required to bring train to full stop ......sec.	16
Distance traversed by train during braking ....ft.	370

TRAIN PERFORMANCE.

Track.	H. P.	Current at 500 Volts. Amp.	Speed Miles. per Hour.	Horiz'l Effort. Lbs.
Level	106	190	32	1,300
1 per cent. grade........	170	290	22	2,780
2 per cent. grade	235	400	20.8	4,260
3 per cent. grade	295	505	19	5,740

The next diagram (Fig. 8) shows a standard Jackson & Sharp truck, equipped with two 125 h. p. L motors, of the

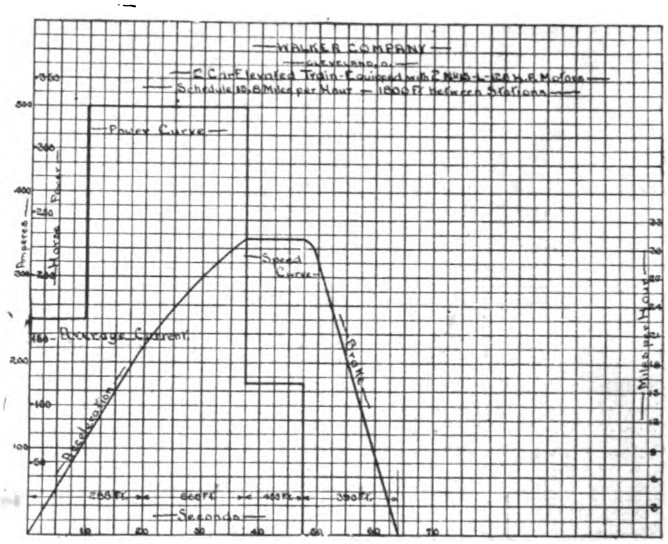


Fig. 11.

same design, capable of moving a standard elevated train of two cars fully loaded, at a schedule speed of 16 miles per hour. Figs. 9, 10 and 11 give a train data sheet (train No. 2) and curves for this equipment.

ELEKTRISCHE BELEUCHTUNGSANLAGEN.—(Electric Light Plants.) By F. Gruenwald. Sixth Edition. Halle a. S. 1896. W. Knapp. 1896. 308 pp. Pocket size. Flexible cover. Price, $1.00.

This work is intended as a guide for those engaged in the erection, operation and repair of electric light plants. The author takes up the various parts of such plants in detail, beginning with the engine and ending, one might say, with the last lamp on the system. Every apparatus met with is thoroughly described, and its operation is clearly set forth. We note quite a number of little wrinkles and details of construction, as well as types of fittings, etc., which might be profitably brought to the attention of American manufacturers and workmen.

AMERICAN STREET RAILWAY INVESTMENTS.—A Supplement to the Street Railway Journal. The Street Railway Journal Publishing Company. 1897. 290 pp. 9½ x 13.

This excellent work includes as usual a tabular presentation of gross receipts, operating expenses and balance sheets for from three to five years of over twelve hundred street railway companies in the United States and Canada. It is interesting to note that of the 1,262 reporting, 939 are operat-

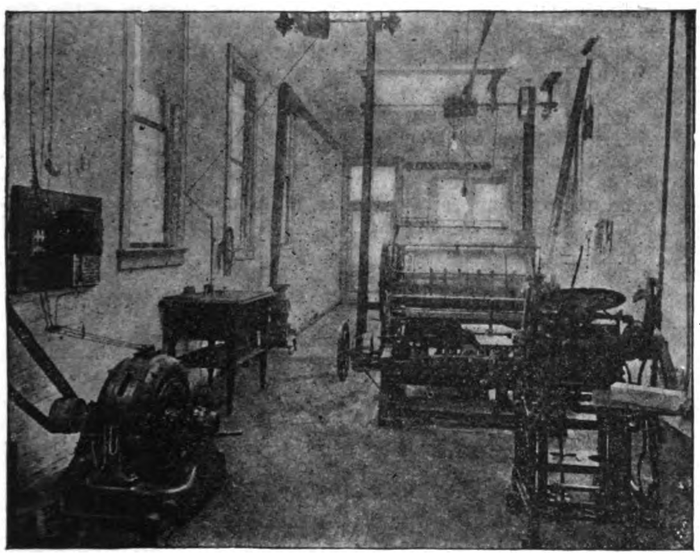
ing companies, 206 are leased companies and 117 are not yet in operation, but with their roads under construction. The "Review of the Year" gives a brief exposition of the principal street railway events during the past year. We also notice a table of "Gross Receipts" in 1895 and 1896, showing the percentage increase or decrease in receipts for every system whose gross receipts exceed $25,000. A number of new maps have been added which add considerably to the value of this excellent work.

POWER TRANSMISSION

ELECTRIC POWER IN SACRAMENTO, CAL.

THE electrification of Sacramento is proceeding apace since the introduction of the current generated at Folsom, twenty-four miles away, demonstrated the cheapness of electrical power when compared with steam power. Electricity is now used in Sacramento to drive machinery of all kinds, and is entering largely into what may be called the household life of the city. One of the most important motor installations is that driving the machinery in the shops of the Southern Pacific Railway Company, recently described in these pages. At about the time this was effected the Buffalo Brewing Company, of Sacramento, substituted motors for the steam engines upon which it had previously been dependent for power, with gratifying results.

This brewery is one of the largest on the Pacific Coast. Its present motor equipment consists of one 5 h. p., one 10 h. p.



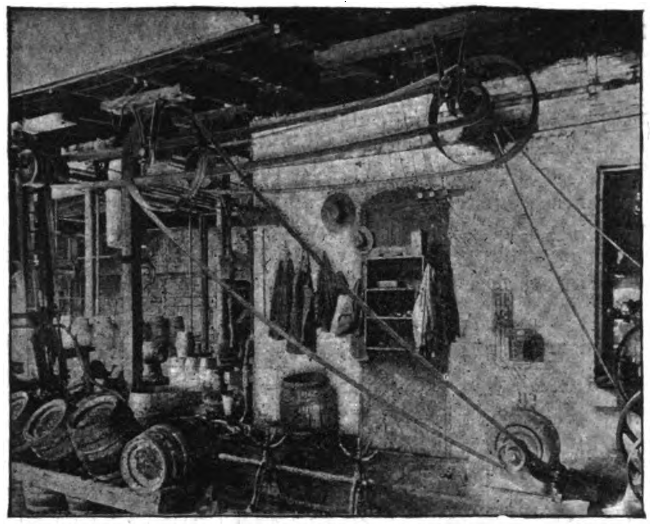
A SACRAMENTO PRINTING OFFICE RUN BY POWER FROM FOLSOM, 24 MILES AWAY.

and one 20 h. p., and two 30 h. p. motors. They are all of the General Electric Company's three-phase induction type, without brushes, collector rings or moving contacts, and run almost without attention beyond an occasional oiling. They are driven by 220-volt current supplied from the 1,000-volt circuit, running from the substation, a distance of two miles, the pressure being transformed down at the brewery.

The smallest motor is used in the bottle-washing house, that of 10 h. p., in the keg-washing department. The three others are used to operate the blowers, the malting house and the machine shops. The large ammonia pumps in the brewery will also shortly be driven by electric motors.

The printing presses of Day & Joy, in Sacramento, are also driven by motor. In this case the motor is of similar type to those in the brewery, but of 10 h. p. capacity. It was one of the first in the city to take current from the long distance transmission. On the day of its installation, the 8 h. p. engine, formerly used, was draped in crape. Its usefulness had departed, with its noise, heat and discomfort. The motor now drives one four-roller Huber cylinder press, one Cottrell press and two job presses, and although it has been in use a number of months has not involved the firm in a cent for repairs.

In installing the Buffalo Brewing Company motors, the question of the probable economy of the change was naturally uppermost. Would it pay to dispense with steam and trust to the motors? The guarantee finally given was, that electricity would show a saving of 40 per cent. After the



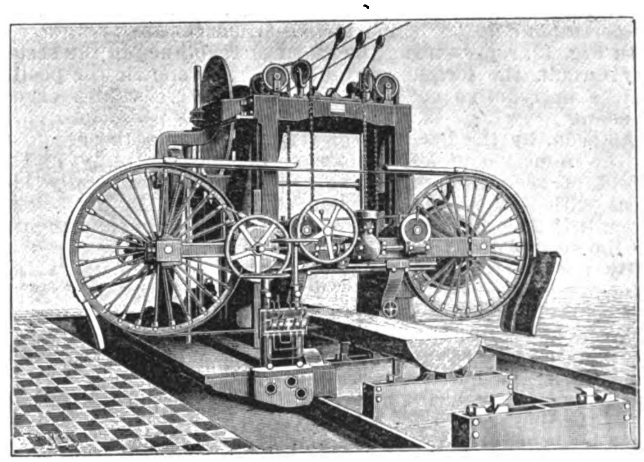
ELECTRIC MOTOR IN SACRAMENTO BREWERY.

motors had been running for some time, a series of tests were made, with the result that the saving instead of 40 per cent. was shown to be actually a little over 50 per cent. Results almost similar have been obtained in other installations in Sacramento. It is hardly a matter of surprise that with such showings to do missionary work, the use of electricity is rapidly extending in that city.

OERLIKON ELECTRIC BAND SAW.

THE Oerlikon Machine Works, Switzerland, have recently constructed a horizontal band saw driven by electric motor, an illustration of which is given in the accompanying engraving, taken from "La Nature." This saw is capable of handling logs up to 1.4 metres (55 inches) in diameter. This new machine consists of a base on which rest the rails and cross-beams to which the logs are fixed and held stationary. The saw is lowered for each cut, the pulleys over which the band saw passes being attached to a cross-head, which can be raised and lowered.

The pulleys are driven by an electric motor of 16 h. p.,



ELECTRIC BAND SAW.

which is shown connected to the pulley at the right-hand side. A simple movement of a lever suffices to raise or lower the saw pulleys.

The band saw travels at a speed of 38 metres per second. The minimum speed of cutting is 34 inches per minute, and the maximum cutting speed is 46 feet per minute. The saw

frame is traversed by a 6 h. p. electric motor. The saw is able to do an enormous amount of work, as several logs can be sawed at the same time. A characteristic of the machine is that the log remains fixed while the saw and the entire superstructure is traversed on rails, the current being taken off by the trolleys shown, and the three-phase current being employed.

THE ALTERNATING CURRENT INDUCTION MOTOR.—III.

BY CHAS. PROTEUS STEINMETZ.

(Concluded.)

FIGS. 12 and 13 give the starting torque, current and torque efficiencies at various resistances and reactances in the secondary and in the primary. In Fig. 12 is gives, with additional armature resistance, R, as abscissæ, the values of starting torque, starting current, power factor, torque efficiency and apparent torque efficiency. In Fig. 13 are given the corresponding values, with reactance inserted in the secondary.

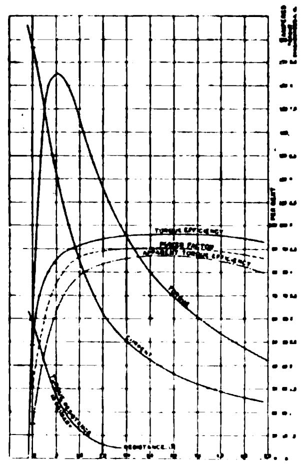


Fig. 12.—Induction Motor. Starting Torque, Current, Efficiencies and Power Factor. $Y = .01 + .1j$. $Z = 1 - .8j$. Resistance in [illegible]

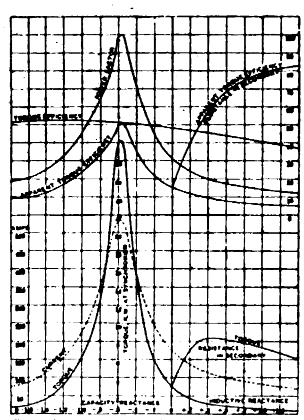


Fig. 13.—Induction Motor. Starting Torque, Current, Efficiencies and Power Factor. $Y = .01 + .1j$. $Z = .1 - .8j$. Reactance in Armature.

FIGS. 12 AND 13.

The insertion of resistance or reactance in the primary has only the effect of decreasing the voltage at the motor terminals and thereby decreasing the torque in proportion to the square of the voltage at the motor terminals, and the apparent torque efficiency directly proportional to the voltage at the motor terminals; that is, is a very inefficient and unsatisfactory means of starting, and suitable by its simplicity only where no starting torque is required, to limit the starting current. By the use of additional resistance in the armature or secondary in starting, torque can be produced, as seen, with the same current power factor, and torque efficiencies as correspond to the same torque when running.

In Fig. 13, representing the effect of reactance in the secondary circuit, the torque, current, etc., are shown for positive values or reactive coils, as well as negative values or condensers.

As seen, by the insertion of reactive coils in the secondary of the induction motor, the torque decreases rapidly, and the effect of secondary inductive reactance is practically identical with that of the insertion of reactance in the primary circuit; that is, the use of inductive reactance in the armature, or the secondary is of no practical value.

By the insertion of negative reactance or capacity, however, torque and current of the motor rise enormously, reaching a maximum of 30,200 synchronous watts and 530 amperes at —.58 ohm additional capacity reactance; that is, 3.66 times the maximum torque available with armature resistance, at 4.22 times the current corresponding thereto. At this point the power factor is 100 per cent.; that is, the current in phase with the impressed e. m. f. On one side of this point the current leads, on the other it lags. Torque efficiency, however, and apparent torque efficiency with the use of capacity in the secondary are very low, the torque efficiency in the whole range being about 50 per cent., while by the use of resistance in the armature a torque efficiency considerably above 90 per cent. is reached. That means, capacity in the secondary, outside of the general inconvenience of the condenser, is far inferior in starting, to the use of non-inductive resistance, except in so far as the maximum available torque is far larger. But the current corresponding to this torque is far beyond the carrying capacity of the motor.

Regulation and Stability.—When operated under these conditions of practice, the induction motor does not give the same margin of overload as when operated at constant impressed voltage. This at once shows the desirability of designing the induction motor with sufficiently large margin of overload, and the necessity of choosing the supply circuit, and especially the transformers, of as low impedance as possible.

As an instance are shown in Figs. 14 and 15, the load curves of the motor discussed in the preceding, rated at 5,000 watts per circuit full load, corresponding to 59 amperes at 110 volts impressed, when operated: (1) At constant impressed voltage of 110 volts. (Fig. 3.) (2) Operated from transformers of 2 per cent. resistance drop and 4 per cent. internal reactance; that is, transformers representing about the best make on the market, of very close regulation. (Fig. 14.) (3) Operated from transformers of 2 per cent. resistance drop and 15 per cent. internal reactance, or about the average type of cheap transformers, at constant primary voltage corresponding to 110 volts at full load at the motor terminals. (Fig. 15.)

In Figs. 14 and 15, the load curves of the motor, the limits of speed and torque curve at constant voltage of 110 are plotted also, showing that the maximum output is reduced under these conditions from 7,000 watts per circuit to 6,450 and 5,780 watts, respectively, and the maximum torque from 8,250 synchronous watts to 7,500 and 6,460, respectively. In consequence thereof, with transformers of poor regulation the motor is at full load already dangerously near the maximum output point, although at constant impressed voltage it has ample margin to carry any reasonable overload.

Still greater is the decrease of voltage, and thus of torque, in starting, especially with low resistance armature, due to the large currents consumed under these circumstances. With an armature containing a variable resistance of sufficient size, limiting the starting current, the starting torque is less affected by the transformer.

If in the installation of the motor the mistake is made not to allow for the drop of voltage taking place even in the best transformers on inductive load, but the ratio of transformation is chosen so as to give the rated motor voltage at the secondary terminals of the transformers at open circuit, output and torque of the motor are still further reduced, and even with the best transformers the margin of overload is only 19.4 per cent. in power and 31 per cent. in torque, while with transformers of poor regulation no margin of torque is left, and the motor cannot carry full load any more. That is, at constant primary voltage corresponding to the rated motor voltage at open circuit at the secondary terminals, the motor can be operated successfully only with the best type of transformers. This fundamental importance of transformer and

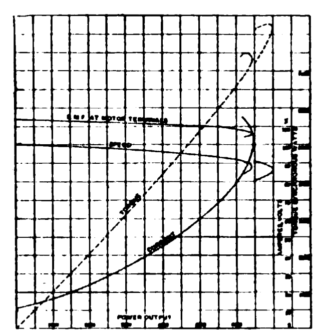


Fig. 14.—Induction Motor. Load Curves. $Y = .01 + .1j$. $Z = .1 - .8j$. Operated from transformers of impedance, $Z = .04 - .08j$, at constant primary potential of 114.1 volts, corresponding to 110 volts at motor terminals at 5000 watts load.

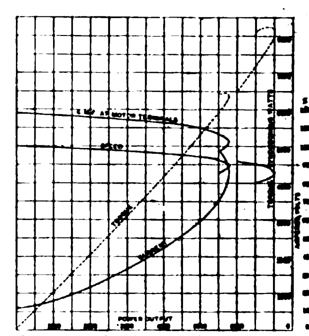


Fig. 15.—Induction Motor. Load Curves. $Y = .01 + .1j$. $Z = .1 - .8j$. Operated from transformers of impedance, $Z = .04 - .3j$, at constant primary potential of 121 volts, corresponding to 110 volts at motor terminals at 5000 watts load.

FIGS. 14 AND 15.

line impedance on the operation of the induction motor has frequently been overlooked. It is, however, analogous to the dropping of torque and output of a continuous current motor, if the impressed voltage drops.

OBITUARY

JAMES W. McDONOUGH.

The death is announced, at Chicago, of J. W. McDonough, who was one of the early claimants for priority in the invention of the telephone, and who had apparently worked out some make-and-break apparatus of

the Reis type. He had been a furniture manufacturer in Chicago, but in 1881 came to New York City, where he acted as electrician for the United States Telephone Company, and for the Schuyler Electric Light Company. He is said to have experimented at that time on various methods of vacuum tube lighting, used both exhausted bulbs and tubes containing carbon dust. He also worked at multiple telephony and for many years, particularly the last twelve, devoted his energies to inventions for photographing in colors.

MR. R. W. LOWBER died last week at his home, Bald Mountain, Washington County, N. Y., aged 72. He is supposed to be the last survivor of the promoters of the New York, Newfoundland and London Telegraph Company, of which he was secretary in 1854.

SOCIETY & CLUB NOTES

FIRE AND POLICE TELEGRAPHERS CONVENTION.

Superintendent Frank C. Mason, of the Brooklyn Police Telegraph, as president of the International Association of Fire and Police Telegraph Superintendents, has issued a call for the annual convention to be held at Nashville, Tenn., on September 14 and 15 next. Two papers of interest to the members will be read during the convention. They will be "Modern Construction and Maintenance of Wires for Municipalities," by William Brophy, of Boston, Mass., and "Storage Batteries and Switchboards as Applied to Fire and Police Work," by J. W. Aydon, of Wilmington, Del. The Old-Time Telegraphers and the United States Military Telegraph Corps will meet in Nashville at the same time.

LEGAL NOTES

MULTIPLE SERIES SYSTEM OF WIRING FOR CAR HEATERS.

We will be glad to have you print the following in your next issue of The Electrical Engineer: "On August 2, Judge Wheeler, of the United States Circuit Court for the Second Circuit, rendered a decision in favor of the defendant in the case of the Burton Electric Company against the Union Railway, of New York, which was defended by the Consolidated Car-Heating Company. This decision settles the right of the Consolidated Company to use the Multiple Series System of Wiring with their electric heaters, and is a decided victory."

CONSOLIDATED CAR-HEATING COMPANY,
F. W. Kelley, Assistant Treasurer.

Albany, N. Y., August 7, 1897.

CONTRACT FOR CURRENT.

The United Electric Light and Power Company, of New York City, contracted with Charles Brenneman to supply light and electric power for fans for the latter's store and restaurant in East Houston street. The contract provided that the consumer should be liable, at a specified rate, as "stipulated damages" for the entire unexpired term of the contract period, in case he "prevents" the company "from supplying the current." Last November Brenneman discontinued the use of electricity for an interval while waiting for a tenant, having determined to go out of the business. Then the company cut out the connection, and brought suit to recover the stipulated damages of $210. The Appellate Term has reversed judgment given in a district court in favor of plaintiff, holding that such liability does not arise where the company cut off the current because it found the premises closed and in partial disuse for a short period.

THREE CENT FARE CASE IN INDIANAPOLIS.

The citizens of Indianapolis are not to have 3-cent street car fares for some time to come. In spite of the decision of the Supreme Court of Indiana holding that the act to reduce fares is not special legislation, and therefore not in conflict with the State constitution, Judge Showalter, of the United States Circuit Court, sustained recently the injunction against the enforcement of the act granted by him some months ago.

In the first place the judge denies that the decision of the Supreme Court of the State is final in this case, because there is a Federal question involved—that the controversy is not merely whether the act in relation to street car fares is special legislation under the Indiana constitution, but whether it is in violation of a contract.

Where a contract is involved, states the judge, and the meaning of it depends on the construction of a State statute or constitution, a decision by the Supreme Court of that State, made after rights have arisen under the contract, is not final, but is reviewable by the Supreme Court of the United States.

VACATING A TROLLEY METHOD INJUNCTION IN NEW YORK CITY.

An order signed by Judge Lacombe was handed down in New York City, in the U. S. Circuit Court, on July 29, vacating the injunction obtained by the Thomson-Houston Electric Company restraining the Union Railway Company, commonly known as the "Huckleberry" Road, and the New York, Elmsford and White Plains Railway Company from using a certain trolley device.

The Thomson-Houston Company claimed to own a patent for the device. The order vacating the injunction is based on the decision of the U. S. Circuit Court of Appeals in the case of the Hoosick Railway Company, of Massachusetts, on July 21, printed in these pages two weeks ago.

CARBON SCREW BATTERY CONNECTORS.

Last January the Phoenix Carbon Company, of St. Louis, bought from the Law Battery Company, of New Jersey, U. S. patent No. 500,284, covering a carbon screw connector for all galvanic battery cells. Holding that this patent was being infringed by the National Carbon Company, of Cleveland, and others, the Phoenix Company brought suit in the United States Court, Eastern District of Ohio, and asked for a restraining injunction. This was granted on June 29, and the Phoenix Company inform us that they are now pressing their suit to obtain judgment. The Phoenix Company say that they will certainly not only stop the National Carbon Company, but any other parties from infringing, and that they will be prepared in a very short time to supply the entire trade with this type, as well as all other types of galvanic batteries. They have enlarged their factory and are filling orders for complete batteries or any battery parts.

REPORTS OF COMPANIES

BOSTON ELECTRIC LIGHT.

The annual report of the Boston Electric Light Company for the year ending June 30 is issued:

	1897.	1896.
Gross income	$759,643	$660,973
Operating expenses	485,498	420,641
Profits	$274,144	$240,331
Interest charges	63,242	50,319
Net for stock	$218,644	$190,012
Dividends	110,500	136,000
Surplus	$108,144	$54,012

THE AFFAIRS OF E. S. GREELEY & CO.

Judge Simeon E. Baldwin, of the Supreme Court, New Haven, Conn., on August 4, sitting as a judge of the Superior Court, signed an order for a hearing on an application of Edwin S. Greeley, receiver of E. S. Greeley & Co., the Dey street electrical supply manufacturers, to sell the uncollected claims of the insolvent concern at public auction, and to pay a dividend on the claims allowed against the corporation. A hearing on the application has been set down for August 16 next. The uncollected bills of the company amount to $15,000. Application has been made to the United States Circuit Court of the Southern District of New York for the removal of the

case to the Superior Court of this county. If this move is successful it is expected that the affairs of the company will be wound up in a few weeks; if not, it is stated that the litigation will be continued for a long time. The amount of the dividend which the receiver is prepared to pay has not yet been announced.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 3, 1897.

Alarms and Signals:—

ELECTRIC SIGNAL DEVICE FOR ELEVATORS. Otto Raacke and Gustav Hensel, St. Louis, Mo., 587,507. Filed March 11, 1897.
Means whereby an alarm is sounded only on the downward approach of the elevator.

ELECTRIC SIGNAL BOX. Albert T. Whittlesey and Fred. B. Dodge, Cleveland, O., 587,565. Filed June 18, 1896.
Details of construction.

AUTOMATIC SWITCH MECHANISM. Jas. E. Tryon, Detroit, Mich., 587,625. Filed Feb. 23, 1897.
An attachment for fire alarm systems.

BURGLAR-ALARM SYSTEM. Wm. T. Arnold, Chicago, Ill., 587,-669. Filed Dec. 15, 1896.
Means for automatically testing the condition of the protecting-circuits.

Conductors, Conduits and Insulators:—

ELECTRIC WIRE HOLDER. Chas. J. Stram, Waterman, Ill., 587,-614. Filed May 27, 1897.
Consists of a piece of rubber provided with an opening and a support for the holder having embracing tongues and a supporting lip.

Distribution:—

OPERATING ALTERNATING MOTORS. Chas. P. Steinmetz, Lynn, Mass., 587,340. Filed Nov. 23, 1893.
Comprises a combination of circuits with a plurality of motors fed from the same source of power supply, whereby they are adapted to run at a speed below that which either one would have if connected directly into the supply circuit.

REGULATING APPARATUS FOR ELECTRICALLY DRIVEN MECHANISM. Walter H. Knight, Newton and Wm. B. Potter, of Lynn, Mass., 587,441. Filed May 21, 1892.
Means by which two driving-motors may be changed from series to multiple connection.

METHOD OF REGULATING ELECTRICALLY DRIVEN MECHANISM. Walter H. Knight, Newton, Mass., and Wm. B. Potter, Lynn, Mass., 587,442. Filed May 21, 1892.
Similar to above.

Dynamos and Motors:—

DYNAMO ELECTRIC MACHINE. Ernest P. Warner and Henry H. Wait, Chicago, Ill., 587,379. Filed June 3, 1896.
The inner face of the pole pieces are slotted to obviate the formation of a local magnetic field.

ELECTRIC MOTOR OR DYNAMO ELECTRIC MACHINE. Robert Lundell, Brooklyn, N. Y., 587,531. Filed Dec. 15, 1896.
The field coils are removable without disturbing the field magnet.

DYNAMO ELECTRIC MACHINE. Valere A. Fynn, Erith, England, 587,573. Filed Aug. 3, 1896.
Comprises an armature composed of two laminated rings and a field magnet having its two sets of poles arranged alternately in different planes transversely to the shaft, the poles of the same polarity acting upon the same armature ring.

DYNAMO ELECTRIC MACHINE. Chas. M. Green, Cleveland, O., 587,576. Filed Nov. 10, 1896.
Comprises a series of commutator rings, armature coils connected with commutator segments at the same side of the armature at which the coils are located, and several sets of commutator brushes to engage the commutator rings.

Electro-Metallurgy:—

COATING METALS BY ELECTROLYSIS. (Reissued). Hans Alexander, Berlin, Germany, 11,624. Filed July 14, 1896.
A heated bath composed of a solution of commercial chlorid of aluminium containing free acid, and chlorid of the coating metal in suitable proportions.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. S. Bergmann and E. Lavens, Brooklyn, N. Y., 587,421. Filed Feb. 7, 1896.
Embodies an inner globe closed at the bottom and having an aperture at the top, and a cap for the aperture.

ELECTRIC ARC LAMP. Edwin F. Taylor, West Chester, Pa., 587,-465. Filed March 18, 1896.
Comprises a cylindrical casing secured to the base of the lamp-frame, a chimney fitting in the casing and secured to the feedrod of the upper carbon and a restricted opening in the top of the chimney.

Miscellaneous:—

ELECTRIC FURNACE. Geo. S. Strong, New York, N. Y., 587,343. Filed Jan. 20, 1896.
Consists in forming electrodes of a mass of material including a material which will bind the mass together under pressure and supplying the current and pressure simultaneously.

ELECTROTHERAPEUTIC APPARATUS. Fred. Geiger, Philadelphia, Pa., 587,436. Filed May 13, 1897.
Apparatus for utilizing commercial currents for electrotherapeutic purposes.

APPARATUS FOR MANUFACTURING CHLORATE OF POTASH BY ELECTROLYSIS. Ferdinand Hurter, Liverpool, England, 587,437. Filed May 8, 1897.
Employs a cathode consisting of a metallic vessel having a porous protective lining.

PROCESS OF AND APPARATUS FOR MAKING METALLIC CARBIDS. Isaiah L. Roberts, Brooklyn, N. Y., 587,509. Filed June 20, 1896.
Consists in moving beneath a horizontal electric arc the metallic compound and carbon to be converted, and in deflecting the arc downward.

ELECTROCUTION CHAIR. Edwin F. Davis, West Caton, N. Y., 587,649. Filed Jan. 6, 1897.
A chair, having means for registering the changes in physical condition of the body of one sitting in the chair and under the influence of an electric current.

DEVICE FOR INSURING CLOSING OF WINDOWS, ETC. H. I. Surye and M. H. Lewis, New York, N. Y., 587,591. Filed March 25, 1897.
Details of construction.

APPARATUS FOR PRODUCING THERMAL RESULTS. H. Sanche, Detroit, Mich., 587,612. Filed May 29, 1890.
Consists of a metallic cylinder connected at one end to a contact plate by a wire cable.

ELECTROLYTIC HEATING APPARATUS. Geo. D. Burton, Boston, Mass., 587,568. Filed Feb. 24, 1897.
Soldering apparatus.

ELECTRIC BALE-TIE MACHINE. W. O. Bates and W. J. Hutchins, Joliet, Ill., 587,296. Filed March 8, 1897.
Details of construction.

Railways and Appliances:—

ELECTRICAL ALARM FOR CARS. A. Nathan, New York, N. Y., 587,534. Filed June 8, 1897.
Operated by batteries, the circuit being closed by discs placed on the shaft of the controller.

ELECTRIC CONTACT. Arthur J. Moxham, Lorain, O., 587,594. Filed Jan. 28, 1897.
A contact box comprising a metallic cover-plate having a perforation and upward projections on each side, the contact being secured in the perforation, but insulated from the projections.

ELECTRIC CONTACT BOX. Wm. Milton Brown, Johnstown, Pa., 587,642. Filed Sept. 30, 1896.
Switching mechanism for contact boxes.

ELECTRIC RAILWAY. Rudolph M. Hunter, Philadelphia, Pa., 587,-674. Filed July 14, 1885.
Sectional conduit system. Details of construction.

Regulation:—

REGULATING ADMISSION OF CURRENTS TO MOTORS. F. E. Herdman, Winnetka, Ill., 587,311. Filed Nov. 27, 1896.
Consists of a centrifugal governor driven by the motor, opreating a device for increasing the current in the armature.

Switches, Cut-Outs, Etc.

ELECTRIC SWITCH. H. W. Smith, Pittsfield, Mass., 587,458. Filed May 5, 1897.
Electric switch terminal.

Telegraphs:—

TELEGRAPHY. Franc Morrison Short, Cleveland, O., 587,336. Filed April 9, 1896.
Means for transmitting fac-simile messages, designs, etc.

TELAUTOGRAPH. Geo. S. Tiffany, Highland Park, Ill., 587,663. Filed June 7, 1895.
Details of construction.

Telephones:—

SIGNAL FOR TELEPHONE SWITCHBOARDS. Chas. E. Scribner, Chicago, Ill., 587,405. Filed Aug. 1, 1895.
Designed to indicate continuously to the attendant the condition of the apparatus at each of two connected substations.

APPARATUS FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 587,406. Filed Dec. 18, 1896.
Line signal for switchboards. Details of construction.

ELECTRIC SIGNALING APPARATUS. Mortimer Du Perow, Washington, Dist. of Columbia, 587,433. Filed July 10, 1895.
Consists in the use of two partial signaling circuits in addition to the telephone speaking circuit.

AUTOMATIC TELEPHONE SYSTEM. Moise Freudenberg, Paris, France, 587,435. Filed Oct. 22, 1896.
Details of construction.

TELEPHONE CENTRAL STATION SIGNALING CIRCUIT. Geo. K. Thompson, Malden, Mass., 587,467. Filed May 25, 1897.
Consists of supplementary glow lamp signals to facilitate the work of "monitors" in exchanges.

CENTRAL OFFICE SWITCHBOARD SYSTEM. Wm. S. Harrison and Edward M. Harrison, Chicago, Ill., 587,502. Filed March 30, 1895.
Details of construction.

TELEPHONE TRANSMITTER. Owen Moran, New York, N. Y., 587,593. Filed Dec. 22, 1896.
Of the granular carbon type. Details of construction.

TELEPHONE TRANSMITTER. Oscar A. Enholm, New York, N. Y., 587,654. Filed Nov. 17, 1896.
Comprises two electrodes, and a composition of an adhesive elastic substance intermixed with conducting material, interposed between them.

PERSONAL

MR. SAMUEL INSULL was in New York last week on business of the National Electric Light and Edison Associations.

MR. LUTHER STIERINGER has left New York for a vacation in the Adirondacks, where he will spend a few weeks.

U. S. SENATOR G. F. HOAR is one of a trolley party making a trip along the North Shore from Boston to Gloucester, the round trip through beautiful country being about seventy-five miles.

THE STOCK MARKET

BROADENING AND BETTERING.

The stock market last week gave many signs of the better feeling in financial circles. Nearly 2,500,000 shares were dealt in, of about 175 different securities, a number far beyond the weekly average for years past, and prices advanced materially all along the line. The course in stocks has, however, been paralleled in other lines. New York bank clearings increased 44 per cent. as compared with a year ago, and thus show a much greater activity in trade. General trade through the country also exhibited great gains. Fifty of the leading railroads show a gain of 4 per cent. in gross earnings for June and of 13 per cent. net. Exports have continued large and wheat is in a stronger position than for years past. To all these and other causes for encouragement the stock market has responded eagerly, with a pace that seems almost too lively for the middle of August.

Of Western Union, 74,245 shares were sold during the week, going from 86 up to 91. General Electric, on sales of 48,130 shares, rose from 35 to 37¼. American Bell Telephone, on sales of 860 shares, went from 228 up to 237½. Brooklyn Elevated, which is soon to adopt electricity, and which was selling at 25 cents a share, $100 par, last Saturday, cannot now be had below 10, an advance in one week of 3,900 per cent.

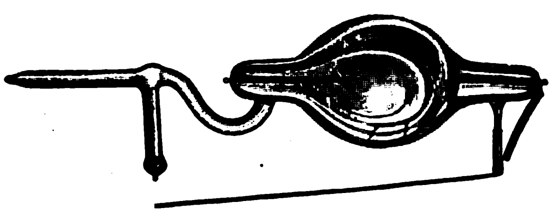
COPPER is quoted in Lake Superior ingot at 10¾; electrolytic bars, 10½. Large exports are being maintained, reaching 11,000 tons of fine copper last month.

STEEL RAILS are in good demand, heavy $19 and upward; light, from $24 to $28.50.

TRADE NOTES & NOVELTIES

SWETT & LEWIS VACUUM TUBE.

The Swett & Lewis Company, of Boston, have just got out a new adjustable vacuum tube; the form of which is the same as that put out by them before. In addition to this, however, is a chemical bulb and a pointer. The pointer works upon a hinge, and can be set so that when the vacuum in the tube gets to the proper height, a spark will pass from the pointer



SWETT & LEWIS VACUUM TUBE.

to the chemical bulb, and hold the vacuum at that point. By this means the tube may be run for hours without any perceptive change in the vacuum. The tube is very simple and easy to operate, and not liable to injury. Large numbers are being sold, and they are hearing very favorable comments from them. To quote from a letter received recently: "I have used the tubes continually, and think them the ideal tube."

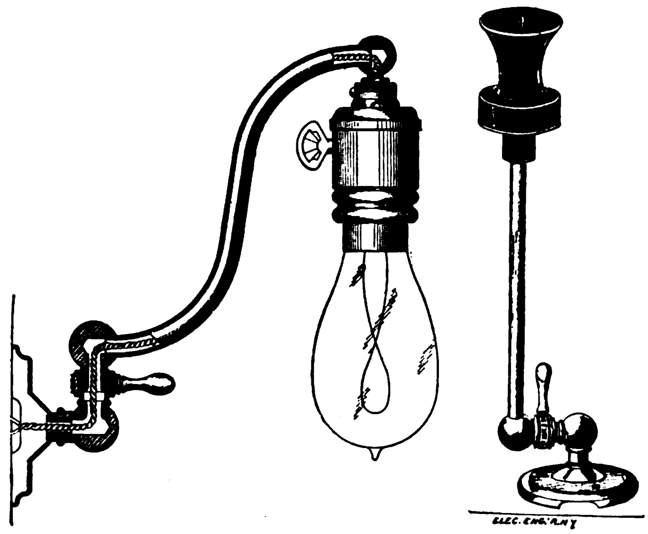
FULLER & CURTIS CO.

The Fuller & Curtis Company has just been incorporated, and will begin the manufacture at Detroit, Mich., of dynamos and other electrical apparatus, and heaters and ventilating appliances. The works are at the intersection of Russell street and the Grand Trunk Railway. The incorporators are Frank E. Kirby, Neil McMillan, C. D. Waterman, Rudolphus Fuller and W. H. Curtis. Mr. Fuller has been for seven years superintendent of the Fontaine Crossing and Electrical Company, and for thirteen years Mr. Curtis has been superintendent of the American Blower Company.

THE PETEREIT ADJUSTABLE SWING FOR ELECTRIC LIGHT OR TELEPHONE BRACKET.

WHEN swinging brackets of ordinary construction are placed on partitions, desks or other places which are not rigid but susceptible to vibration, the bracket is liable to be moved accidentally, and some means must be provided for quickly locking and unlocking it.

To provide a ready means of adjustment, such that the bracket can be movable or stationary, Mr. Albert Petereit, of



FIGS. 1 AND 2.—PETEREIT ADJUSTABLE BRACKET.

the Petereit-Wehrle Manufacturing Company, 140 Sullivan street, New York, has recently patented the device illustrated in the accompanying engravings.

As will be seen, the nozzle at the side of the lower ball, receives a nipple by which it is attached to the wall or desk bracket, while the swing is fitted into the upper ball. Between them is the lock nut, the actuating device of the invention. When the lock nut is quite loose, the joint will revolve freely, but cannot be accidentally displaced. When it is desired to have it remain in any position in which it is left, the lock is slightly tightened by being screwed down on the

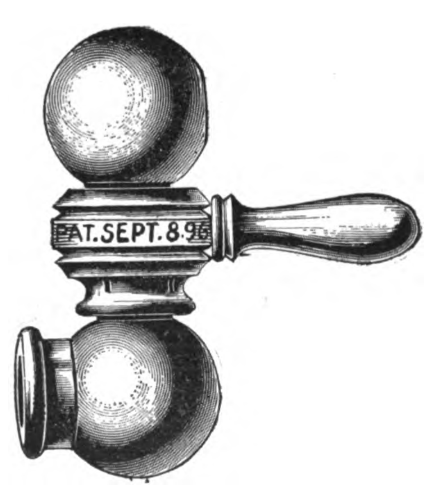


FIG. 3.—PETEREIT ADJUSTABLE BRACKET.

threaded nipple on which it works. This prevents the removal of the swing. When the lock nut is tightened still more the joint ceases to rotate, and will stay in any position in which it is left. When a proper adjustment has been made —that is, when the joint swings with just sufficient friction, the handle of the lock nut may be unscrewed and removed and then the lock nut cannot be moved except by tools, or by replacing the handle. The wiring can be very simply effected, as will be noted in Fig. 1.

Fig. 2 shows the device attached to a telephone transmitter.

WARD LEONARD ELECTRIC CO.'S CATALOGUE.

It is little more than five years since the enamel rheostat was called into existence, and yet the strides which have been made in the application of this exceedingly useful device have been enormous. We are forcibly reminded of the latter fact by a glance through the ninth catalogue just issued by the Ward Leonard Electric Company, of Hoboken, N. J., manufacturers of the Carpenter and Ward Leonard types of enamel rheostats.

The catalogue is replete with illustrations of a large variety of rheostats, reaching into the hundreds, standardized for use as field regulators, motor starters, theater dimmers, ventilating fan regulators, etc. A special feature of the catalogue is the description of the universal automatic motor starting rheostats, the automatic circuit breaker, which releases with "overload" and "no voltage"; the reversing controllers and other similar devices to which the Leonard Company have devoted special attention.

On glancing through the catalogue we note that a very marked reduction has been made in the price of the company's goods, a reduction averaging 25 per cent., and much more than this in the case of motor rheostats.

The Ward-Leonard Electric Company believe that they are one of the few electrical manufacturing concerns whose business has steadily increased during the last five years, and they attribute a great deal of their success to the comprehensiveness of their catalogues, from which electrical people both here and abroad have been able to order any desired rheostat with complete accuracy by a single code word or catalogue number.

The Leonard Company is represented in England by Veritys, Limited, London, and in Germany by S. Bergmann & Co., Berlin.

ADVERTISERS' HINTS

THE JEWELL BELTING COMPANY, Hartford, Conn., are advertising belt cement, belt dressing and pulley covering.

THE IDEAL ELECTRIC CORPORATION, Thirteenth and Hudson streets, New York, invite requests for estimates and prices on switchboards, panel boards and all copper switches.

OSTERBERG & SUTTON, Bowling Green Building, New York, consulting engineers and electrical experts, are making a specialty of gas and oil engine plants.

THE ORIENT ELECTRICAL COMPANY, Youngstown, O., still quote 17 cents on 10 and 16 c. p. lamps in barrel lots.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, Ill., say the Packard transformers are the nearest to perfection ever produced.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., continue to publish results obtained by the adoption of their system of heating by exhaust steam.

THE GENERAL ELECTRIC COMPANY advertise the Wirt short-gap lightning arresters for alternating circuits of any potential. They are in use on the Niagara-Buffalo transmission line.

NEW YORK NOTES.

THE HARMONIE CLUB, in West Forty-second street, is one of the prominent German clubs in the city, is undergoing considerable changes, one of the principal features being a ladies' club, which is being built as an annex to the present club house. Messrs. Herts, Tallant and Newton are the architects, and they have retained the firm of Osterberg & Sutton as consulting electrical engineers. This latter firm has also prepared plans and specification for a complete system of heating and ventilation, which having been approved of by the architects, will be adopted throughout the building. Quite a number of important features will be introduced in this new building, especially as far as electricity is concerned. A new electric elevator and a number of direct connected electric ventilators will be installed. The stage lights are being specially designed for artistic effects and the call system in the smoking and lounging rooms will have some special arrangements for the convenience of the members, which the engineers will not at present speak about. Work is to be commenced almost immediately.

WESTERN NOTES

WESTERN ELECTRIC COMPANY, Chicago, report that their "Economy" battery is meeting with considerable favor. This battery, which is of a high grade carbon type, has very good qualities and is sold at a low price. These combined advantages have been the means of creating quite a demand for it, which is still on the increase. The Western Electric Company have just completed a catalogue of the parts of single carbon high tension arc lamps, which gives illustrations, particulars and prices of even the most minute article used in these lamps, and users of arc lamps will find it to their advantage to have one of these catalogues at hand. The handsome picture of Niagara Falls, which is mounted on cardboard and termed "A Great Source of Supply," recently issued gratis by this company, presents a very attractive addition to the walls of an office or sitting-room.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXIV. AUGUST 19, 1897. No. 485.

ELECTRIC TRANSPORTATION

THE NEW CONDUIT RAILWAY WORK IN NEW YORK.

AFTER several months of delay, caused by legal complications, the Metropolitan Street Railway Company, of New York, is now actively engaged in converting the present horse roads on Eighth and Madison avenues into electric conduit roads.

In planning the new work the engineers of the company have been guided largely by the experience gained in the operation of the Lenox avenue conduit road which is now in its second year.

Our engraving, Fig. 1, shows a section of the conduit. As will be noted, the entire depth of the yoke is only 2 feet 6¾ inches, so that but a very shallow excavation will be required, in marked contrast to the usual depth of a cable conduit. The yokes will be spaced 5 feet on centers, and the hand holes where the insulators are attached, at distances of 15 feet.

The conducting rail is a modified T-section, with the edges lapped over, so as to give additional stiffness to resist the pressure of the plow contacts.

The conducting rails are held in position by fork brackets, which are held firmly by porcelain insulators. Fig. 2 shows one of these insulators in part section. These differ somewhat in construction from those used on the Lenox avenue line. They are supported at two points and bolted to the slot rail and conductor rail. The insulator is enclosed in an outer inverted bell of cast iron; within this is cemented the glazed porcelain insulator, and inside of this is cemented the steel screw pin that supports the fork to which the conductor rail is attached. The insulator is 7¼ inches high over all and the conductor rail is 14 inches below the top of the slot rail.

The construction adopted at manholes and cleaning pits is shown in the illustration, Fig. 3. The manholes are 5 feet deep below the surface, with catchbasins connected to the sewer. These are placed 150 feet apart on levels, but at more frequent intervals on grades. The pits are also employed for connecting the feeders to the conductor bars. It will be noted that the yokes of the conduit have a stiffening web cast on at the bottom, which is embedded in concrete; this enables a shallower construction of conduit to be employed.

In order to provide current for the new lines the company is installing two new electric power plants. One of these is situated in the present cable power house on East Twenty-

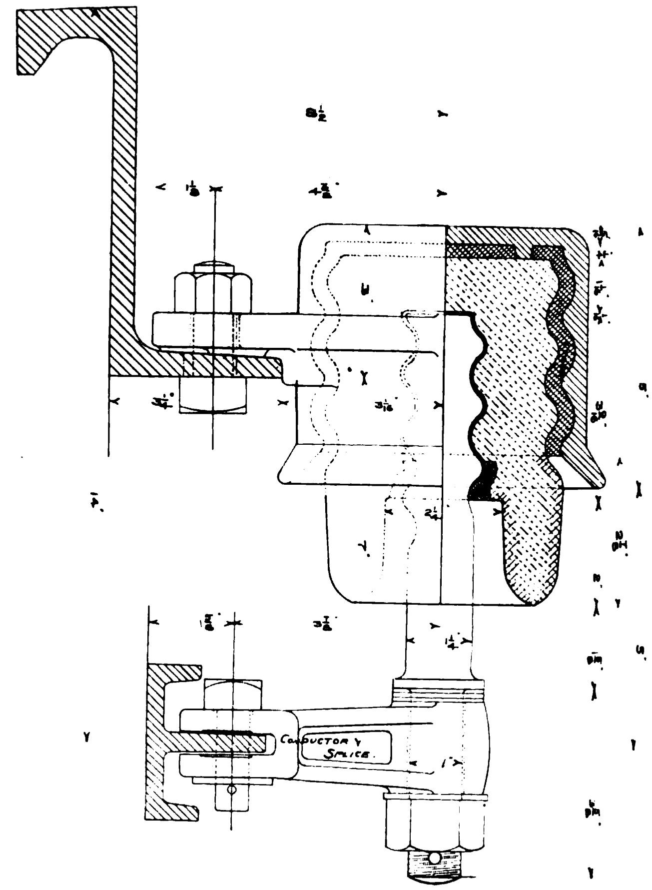


FIG. 2.—INSULATOR FOR NEW CONDUIT ROADS IN NEW YORK.

fifth street, and is shown in plan in Fig. 4. Placed alongside the present cable drives there will be ranged four 800 k. w. G. E. generators, driven by cross-compound engines, built by

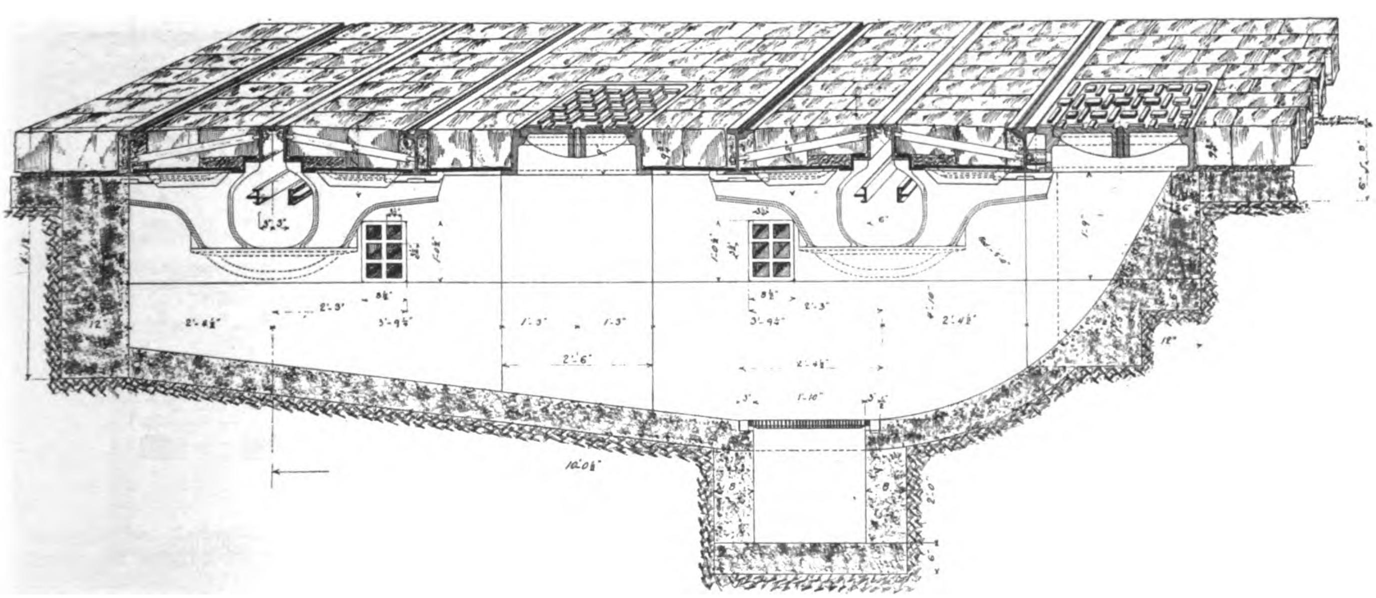


FIG. 3.—MAN HOLE AND CLEANING PITS, NEW CONDUIT ROAD CONSTRUCTION, NEW YORK.

The rails will be 9 inches high, weighing 106 pounds to the yard, with a 7-inch slot rail, the latter similar to that employed on the company's present cable system.

the Pennsylvania Iron Works Company, of Philadelphia. To provide steam for these new engines 8 additional Babcock & Wilcox boilers will be installed, of 250 h. p. each, Fig. 5.

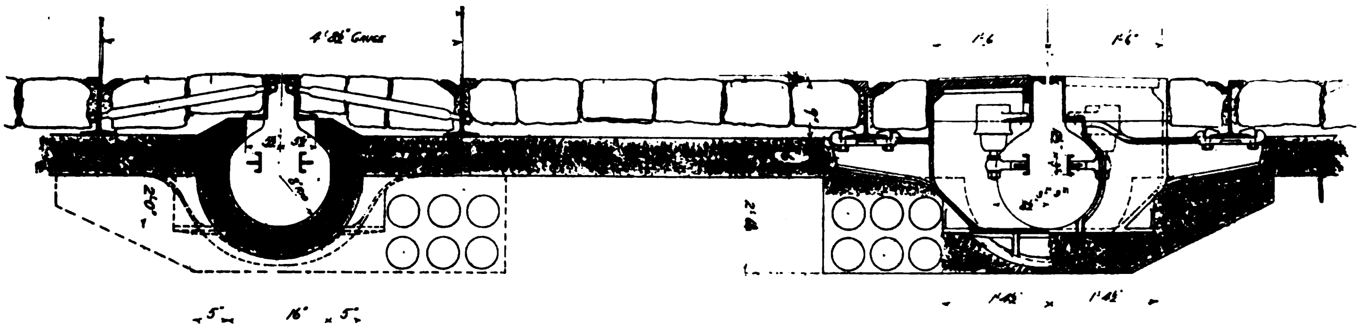


Fig. 1.—Section of New Electric Conduit Roads, New York.

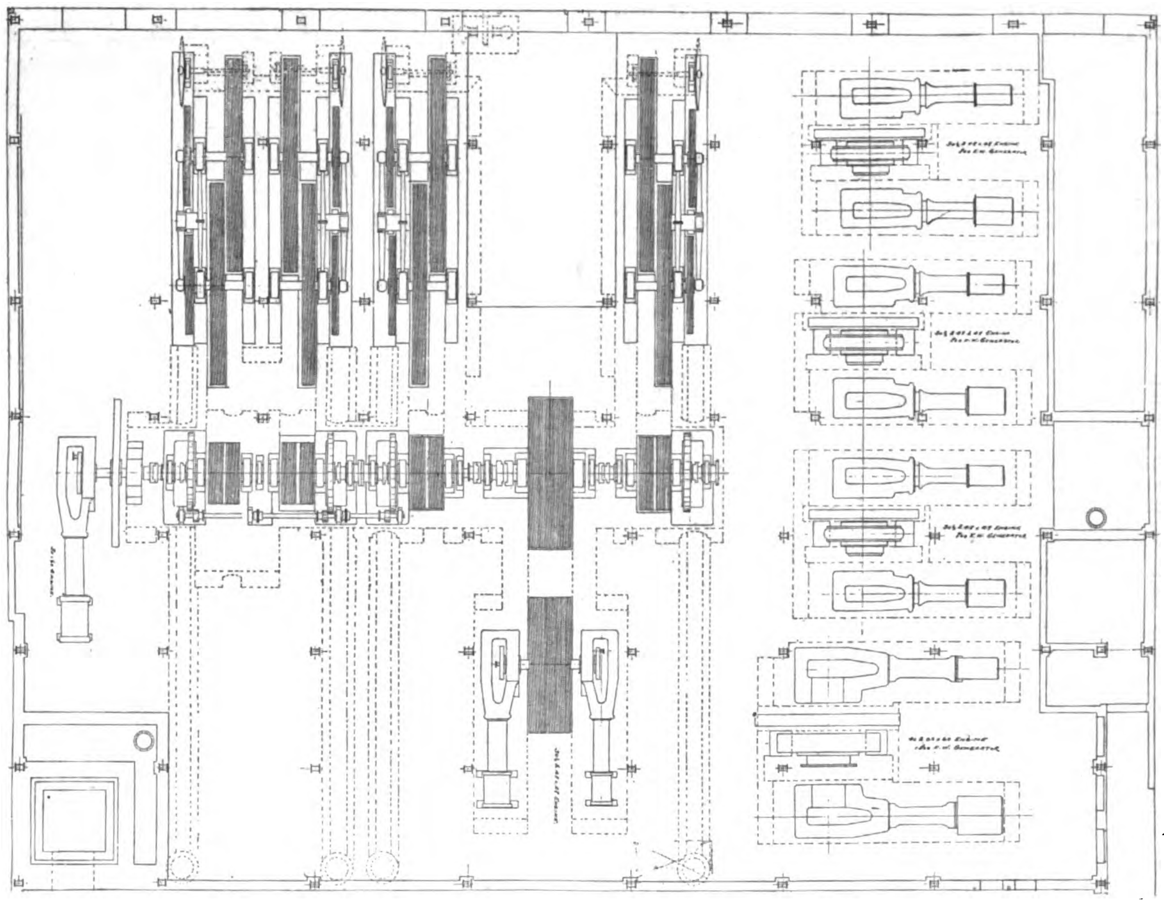


Fig. 4.—Arrangement of Generators in 25th Street Railway Power House, New York.

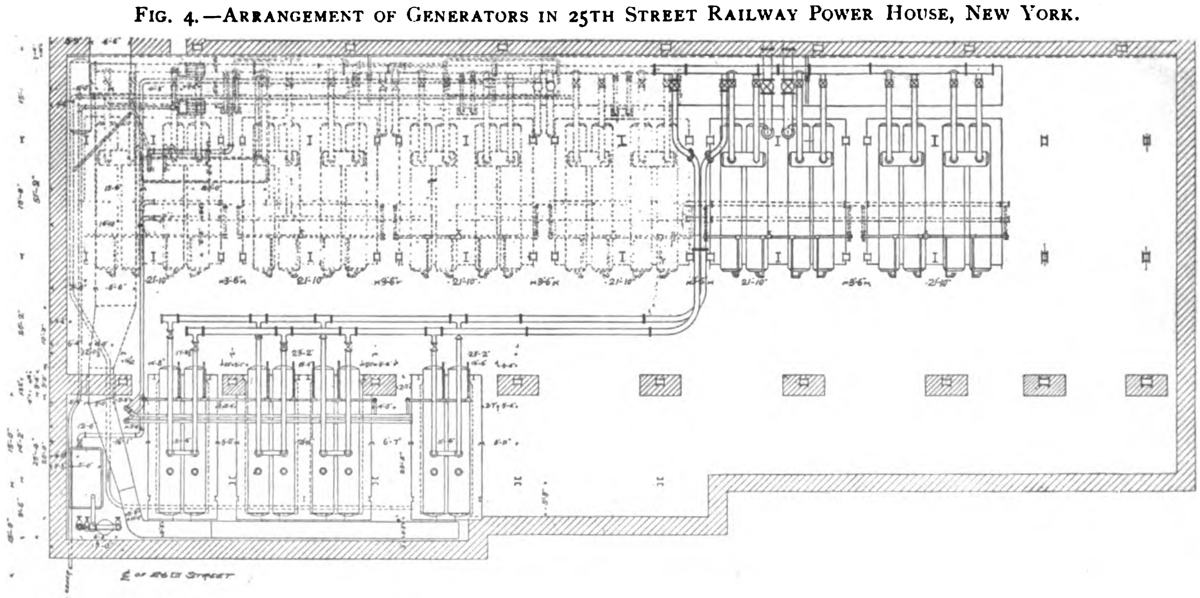


Fig. 5.—Boiler Arrangement in 25th Street Railway Power House, New York.

Owing to the lack of space, one-half of the new boilers will be placed under the sidewalk, as shown in the sectional view, Fig. 6, and these will be provided with the Box automatic stokers.

This station will supply current to all lines below Fifty-

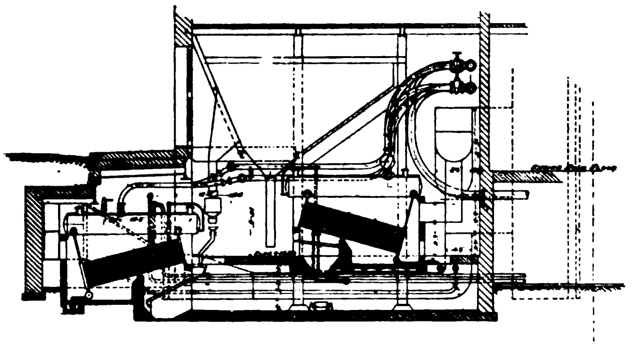


Fig. 6.—Section of Boiler House.

ninth street. Above this point current will be furnished from the 146th street station, which now supplies the Lenox avenue line. This station is now being extended to make room for the new power equipment.

ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.—III.

BY PROF. S. H. SHORT.

TRAIN No. 2.

Character of Service; Elevated Railway:

Number of cars in train	2
Full speed of train on level track (miles per hour)	31
Average speeds, stops ⅓ mile apart	15.8

Motor Car.

Weight of motor car body ....tons	10
Weight of both trucks ....tons	10
Weight of two motors ....tons	5.5
Weight of seventy-five passengers ....tons	5
Total weight of loaded motor car ....tons	30.5
Number of motors on motor car	2
Commercial rated power of each ....h. p.	125
Safe constant load for each	60
Safe temporary tractive effort of equipment ....lbs.	5,600
Safe constant tractive effort of equipment ....lbs.	1,600

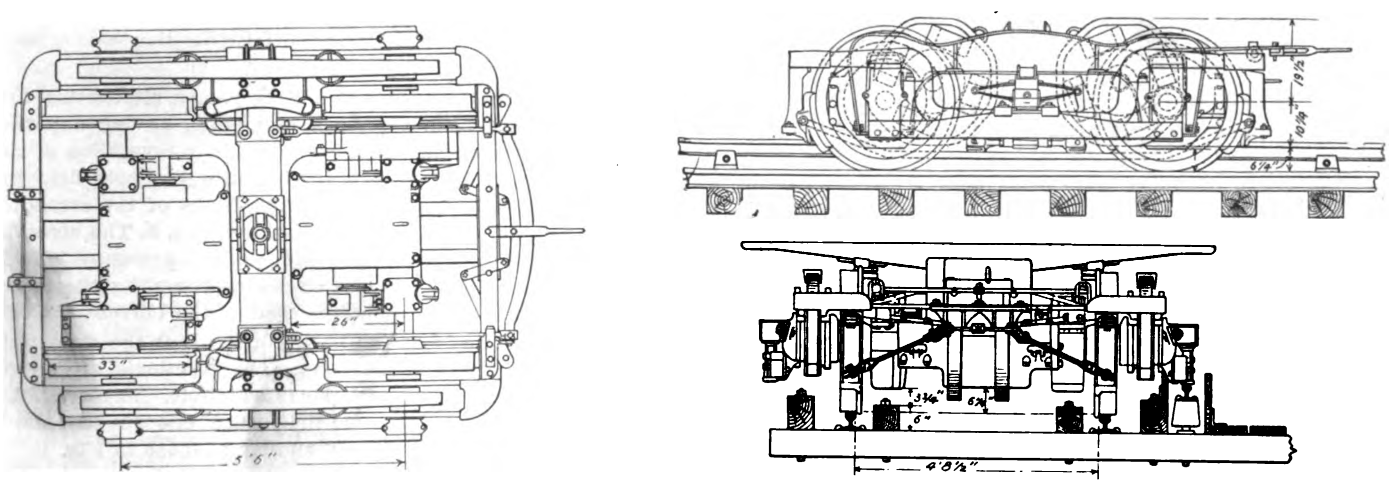


Fig. 12.

Weight on drivers ....tons	18
Ratio of weight on drivers to total weight	35%

TRAIN No. 3.

Elevated Railway Service:

Number of cars in train	1
Full speed of train on level track (miles per hour)	26
Average speed, stops ⅓ mile apart (miles per hour)	15

Motor Car.

Weight of motor car body ....tons	10
Weight of both trucks ....tons	10
Weight of seventy-five passengers ....tons	5
Weight of two motors ....tons	3.5
Total weight of loaded motor car ....tons	28.5
Number of motors on motor car	2
Commercial rated power of each ....h. p.	60
Safe constant load for each ....h. p.	25
Safe temporary tractive effort of equipment ....lbs.	3,300
Safe constant tractive effort of equipment ....lbs.	700
Weight on drivers ....tons	16

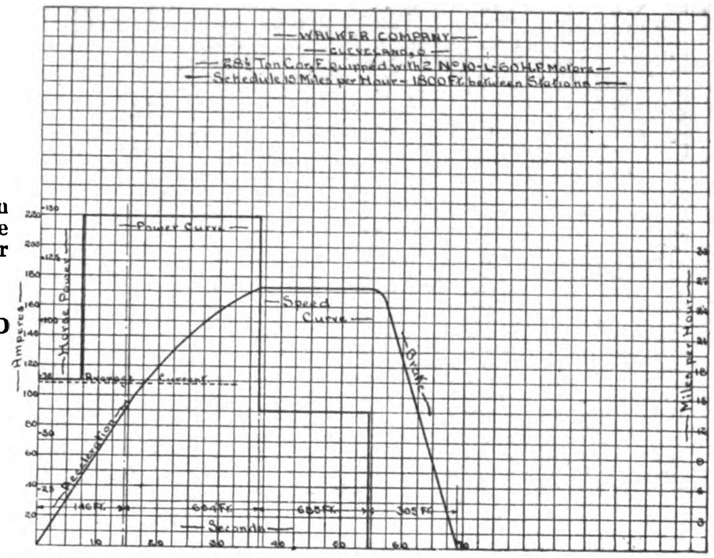


Fig. 13.

Ratio of weight on drivers to total weight	56%
Adhesive power ....lbs.	8,000
Ratio safe temporary tractive effort to adhesion	41%
Ratio safe constant tractive effort to adhesion	8%
Adhesive power ....lbs.	9,000
Ratio safe temporary tractive effort to adhesion	62%
Ratio safe constant tractive effort to adhesion	18%

Complete Train.

Total weight of loaded motor car ....tons	30.5
Weight of one coach ....tons	16
Weight of seventy-five passengers in coach ....tons	5
	51.5
Maximum horizontal effort in accelerating train ....lbs.	5,640
Horizontal effort per ton during acceleration ....lbs.	109
Maximum power in accelerating uniformly to full speed ....h. p.	280

Maximum current at 500 volts accelerating uniformly to full speed ....amp.	500
Time required in accelerating uniformly to full speed ....sec.	37.5
Distance in which train will acquire full speed...ft.	953
Horizontal effort, train running uniform speed..lbs.	1,000
Power consumed, train running uniform speed.h. p.	115
Tractive effort per ton, running uniform speed..lbs.	19.7
Maximum practical negative horizontal effort in braking................ ....lbs.	11,000
Time required to bring train to full stop.......sec.	16
Distance traversed by train during braking......ft.	390

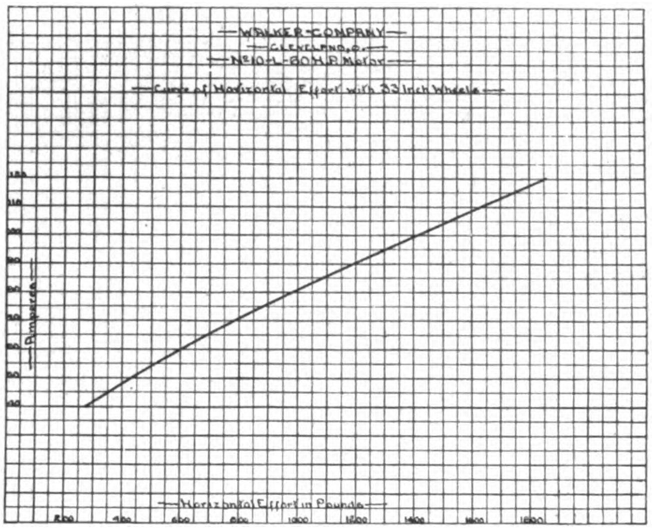


FIG. 14.

TRAIN PERFORMANCE.

Track.	H. P.	Current at 500 Volts. Amp.	Speed Miles. per Hour.	Horiz'l Effort. Lbs.
Level	92	175	31	1,013
1 per cent. grade	135	250	24.8	2,043
2 per cent. grade	176	320	21.3	3,073
3 per cent. grade	220	390	19.9	4,103

The next diagram (Fig. 12) shows two 60 h. p. motors of the L type, mounted upon a standard McGuire truck, ca-

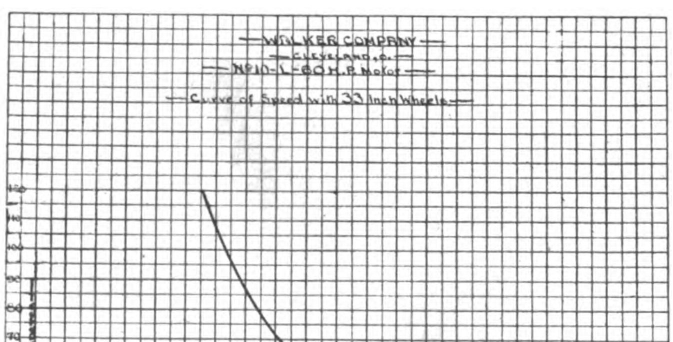


FIG. 15.

pable of operating a single standard elevated coach at a schedule speed of 15½ miles per hour, with its corresponding train data sheet (train No. 3) and curves (Figs. 13, 14 and 15).

Complete Train.

Total weight of loaded train ....tons	28.5
Maximum horizontal effort in accelerating train.lbs.	2,600
Horizontal effort per ton during acceleration..lbs.	91.5
Maximum power in accelerating uniformly to full speed ....h. p.	122
Maximum current at 550 volts accelerating uniformly to full speed ....amp.	220
Times required in accelerating uniformly to full speed ....sec.	36.5
Distance in which train will acquire full speed..ft.	810
Horizontal effort, train running uniform speed..lbs.	712
Power consumed, train running uniform speed.h. p.	51
Time required in accelerating uniformly to full speed ....lbs.	25
Maximum practical negative horizontal effort in braking ....lbs.	5,300
Time required to bring train to full stop........sec.	14.5
Distance traversed by train during braking.....ft.	305

TRAIN PERFORMANCE.

Track.	H. P.	Current at 500 Volts. Amp.	Speed Miles. per Hour.	Horiz'l Effort. Lbs.
Level	51	90	26	712
1 per cent. grade	68	124	19.9	1,282
2 per cent. grade	85	154	17.2	1,832
3 per cent. grade	101	182	15.5	2,422

For the convenience of engineers making calculations for the required current in amperes at 500 volts pressure, which will be necessary to operate a given line of road with trains as specified above, the table herewith (Fig. 16) is given, showing the maximum current consumed by trains during acceler-

Standard Elevated Ry. Cars.

Number of Cars	Accelerating Current	Full Speed Current	Average Current	Average Horse Power
1	220	90	180	121
2	500	175	227	152
3	780	190	348	231

FIG. 16.

ation; the current necessary to operate the trains at full speed, and the average current and horse-power for the various trains.

MISCELLANEOUS

ROTARY TRANSFORMERS.—II.

BY C. F. SCOTT.

ALTERNATING Current in a Rotary.—An alternating current varies from zero to a maximum, having a particular value for each successive position in a revolution of the armature. In an armature revolving in a two-pole field the current strengths for a number of positions of the armature are shown in the accompanying diagram, Fig. 5. The strength of current in the wires on the surface of the armature is indicated by the thickness of the circles representing the armature. The shaded portion indicates that the current is flowing in one direction and the light portion that the current is flowing in the opposite direction. The terminals are represented by black dots within the inner circle. The armature is assumed to be between two field poles, one directly above and the other directly below it, similar to those in Fig. 1.

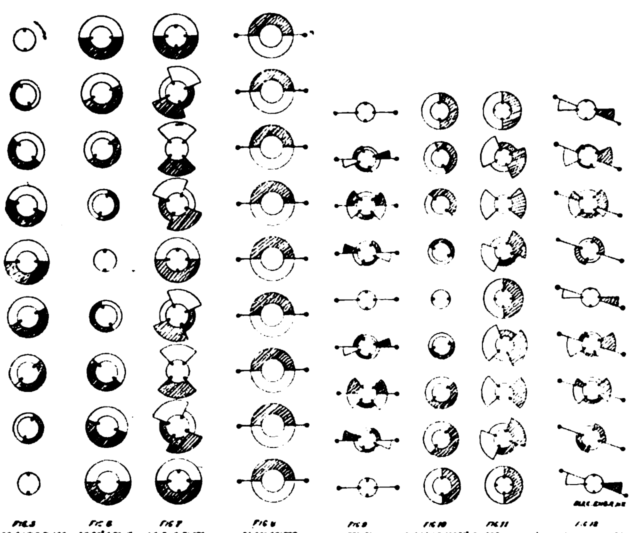
The upper circle in the figure represents the armature in the position of zero e. m. f. and of zero current also, when the e. m. f. and current are of the same phase. The second circle shows the condition when the armature is moved through one-quarter of a right angle, or 22½ degs. The e. m. f. and current are not 38 degs. of the maximum which will be reached, and they are in one direction of the shaded section of the diagram, and in the opposite direction in the other half.

The next circle shows the 45 deg. position, in which the strength of the current is 71 degs., and the fourth circle shows the condition when the next arc has been passed and the value is 92 degs. of its maximum. The fifth circle shows

the 90 deg. position, in which e. m. f. and current have reached their maximum values. This circle represents the same condition that was shown in Fig. 1; the half of the armature nearest one pole is carrying current in one direction, while that nearest the other pole is carrying current in the opposite direction. A vertical line passing through the center of the poles and the armature is seen to have an equal quantity of positive and of negative armature current on each side; as the result the armature currents do not have any effect in increasing or diminishing the magnetization of the fields. The conditions for the next quarter of a revolution are given in the lower circles, and the conditions in subsequent positions are simply a recurrence of the cycle, which is shown in the nine circles given.

In a two-phase machine the two e. m. f.'s are exactly similar, except that one occurs 90 degs., or a quarter of a revolution later than the other. The connections to the armature winding are exactly similar, except that one is made at a point 90 degs. from the other. The e. m. f. and current in the second circuit are, therefore, identical with those which were in the first circuit a quarter of a revolution before. Diagrams for the second circuit are given in Fig. 6. A comparison of Fig. 5 and Fig. 6 shows that the current in one is maximum when that in the other is zero.

If both circuits be derived from the same winding then the two currents tend to flow in the same wires, and the actual current flowing is the resultant of the two. It will be the sum when the two currents are flowing in the same direction and the difference when they are flowing in the opposite direction. Combining Figs. 5 and 6 in this way Fig. 7 is derived. The upper circle is seen to correspond exactly with that of Fig. 6, as there is no current in Fig. 5 at this time. The condition obtained at each quarter revolution is the same, and is shown by the first, fifth and ninth circles. The current in the intermediate positions is seen to be different in different sections of the armature winding. In the 45 deg. position there are two quarters of the armature which have no current. It will be observed that the area in Fig. 7 is considerably less than the sum of the areas in the two figures representing the component currents. If the current in the armature wires of Fig. 5 and of Fig. 6 is represented by 1 in each case, then the current in the armature when both circuits supply their currents from one winding, as on Fig. 7, will not be equal to the sum of two, or 2, but will be equal to 1.4.



FIGS. 5 TO 12.

A vertical line drawn through the nine circles in each of the three figures shows an equal area of shaded section and an equal area of light section on each side, so that there is no resultant effect on the magnetization of the fields.

Direct Current in a Rotary.—The current in an armature of a direct current machine, in which the brushes are set in a neutral position, having no lead, is shown in Fig. 8. It will be noted that the current in all parts of the armature is of the same strength, and that the current occupies the same position with respect to the field poles regardless of the angular position of any particular armature conductor.

An armature which carries both the alternating current and the direct current in the same winding will have a resultant current, which is the sum of the two in those conductors in which the currents tend to flow in opposite directions. The successive circles in Fig. 7 (which represent the current in a two-phase alternating current motor), and in Fig. 8 (which represent the current in a direct current dynamo), are combined to give the corresponding circles in Fig. 9, which, therefore, represent the actual current in the armature conductors of a rotary transformer in successive positions. It will be observed that in the first position there is no current in the armature. In this position one of the alternating current circuits is delivering no current and the other is delivering its maximum current. The latter circuit is at this moment connected to those commutator bars on which the direct current brushes are making contact, so that the current passes directly from the alternating current circuit to the direct current circuit, without transversing the armature winding. The same condition prevails when the armature has moved through 90 degs., and the commutator bars to which the second circuit is connected have come under the direct current brushes and the current in this alternating circuit has reached its maximum value. The continuous strength of the direct current is just equal to the maximum value of the alternating current. In intermediate positions of the armature the current varies through a considerable range, as is indicated by the intermediate circles.

The figures clearly indicate that the current in the armature conductors is less when the machine is used as a rotary transformer than it is when used as a direct current generator. An inspection of the circles in the figure representing the rotary shows that the current in the armature conductors which are directly in front of the field poles—that is, on the upper and lower portions of the circles, is very much less than it is in the figure representing the direct current generator. As a consequence the distortion of the field magnetism is very much reduced and the conditions for commutation are, therefore, greatly improved. The iron losses arising from field distortion are very small in the rotary, as there is so little distortion.

The Induction Rotary.—It has been stated that if the field current of a synchronous machine be reduced there will be an increased armature current, which can compensate for the decreased field current and maintain a constant magnetization. In a suitably designed machine the field current may be reduced to zero, and the whole magnetization derived from the armature current. The current in this case, as has been shown in Fig. 2, has its maximum value in quadrature, or 90 degs. from the maximum e. m. f. A single-phase armature, in which the current is in phase with the e. m. f., is represented in Fig. 5. If the current lag 90 degs., then the relation of currents may be seen in Fig. 10, in which the current has its maximum value in a position 90 degs. later than that at which the maximum value occurs in Fig. 5. It will readily be seen that in Fig. 10 the current represented by the shaded portion of the diagram is almost entirely on one side of the vertical line, so that the currents in the armature are in proper position for magnetizing the field. The current in the armature of a two-phase motor which is magnetized by the armature currents is shown in Fig. 11. It will be noted that the current is distributed in the same way as in Fig. 7, which represents a two-phase motor in which the currents are in phase with the e. m. f.'s, except that the corresponding currents occur when the armature is moved through 90 degs. The position of the current in the armature is such that the shaded portion lies almost entirely on one side of the vertical line passing through the center of the shaft and the field poles, and consequently is in the most favorable position for magnetizing the fields. If such an induction motor be provided with a commutator, direct current may be delivered and the action of the machine will be essentially the same as if it were excited by current in a field winding instead of current in the armature winding.

The magnetizing effect must be practically constant at all times. The current in phase with the e. m. f., which therefore supplies energy, which is in turn delivered to the direct current circuit, varies with the load. The resultant current therefore varies with the load. It will be found that the alternating current to the motor, as well as the currents in the armature windings, is not equal to the arithmetical sum of the magnetizing current, which can be measured at no load, and the current which is useful in supplying the direct current circuit. The resultant current is less than the sum, and the difference becomes greater and greater as the motor is loaded.

Effect of Change of Lead.—An interesting and important variation is produced when the angular position or lead of the direct current brushes is changed. Omitting for the present the lagging or magnetizing current and considering only the current which is in phase with the e. m. f. and supplies energy for the direct current, the distribution of current with no lead is shown in Fig. 9, and with backward lead of 22½

degs. is shown in Fig. 12. The currents in these figures are similar except in the arcs through which the brushes have been moved from their neutral position. In Fig. 9 it was noted that there was no magnetizing effect produced in the field of the armature current. In Fig. 12 it will be observed that the currents in the sections in which the brushes have been moved are so located as to produce considerable magnetizing effect; as there is a current in one direction on one side of the armature and in the other direction on the other side of the armature. When the brushes have this position the current in the armature resulting from the currents which are in phase with their e. m. f.'s and which supply the direct current produce a magnetizing effect which will therefore reduce the amount of magnetizing current necessary from other sources. In an induction rotary in which the brushes are given a backward lead this effect can be secured, thus requiring a less amount of lagging current, or current which is 90 degs. behind its e. m. f., when the machine is loaded.

As stated above, if the brushes are given a backward lead the magnetizing current will decrease, while if they be given a forward lead it will increase. This effect is useful in regulating the voltage of the direct current delivered by the induction rotary.

The induction rotary possesses essentially the same characteristics as the rotary with excited field in the increase of output, which can be obtained from an armature of given size over that which can be obtained from a direct current machine.

The induction rotary possesses great superiority over the rotary with excited field in its facility for adapting itself to the conditions of the circuit. A synchronous machine, as has been pointed out, must be adapted to the circuit which supplies it in wave form and in e. m. f. An induction machine has no characteristic wave form nor e. m. f. In these respects it is not active but passive. It receives its magnetizing current from the alternating circuit in the same way that an ordinary transformer or converter does. In these regards the induction rotary possesses the same marked advantages over the rotary with excited fields as the induction motor possesses over the synchronous motor with excited field.

The induction rotary has sufficient starting torque to be self-starting. The rotary with excited field is in general capable of self-starting, but under conditions which are not as favorable to the circuit as the induction rotary, as the latter requires much less starting current.

When the conditions of speed or e. m. f. on a circuit are fluctuating, the induction rotary is much less liable to be affected than the rotary with excited field. In fact, in a certain test a rotary transformer of the direct current field type was so sensitive to variations in the circuit that it could not be operated from a commercial circuit, but was able to run with perfect steadiness as an induction rotary when its field circuit was open. The machine was not properly proportioned for running continuously as an induction rotary, as the exciting current was excessive. This, however, could be modified by making slight changes in the design on the machine, adapting it for operation as an induction rotary. I have seen two induction rotaries running in multiple which divided the load in any ratio that was desired, depending on the relative lead of the brushes. The induction rotary is best suited to circuits of a low number of alternations, and, except in small sizes, is not well adapted for 7,200 alternations or 60-cycle circuits.

Regulation of Voltage.—The e. m. f. at the commutator of a rotary is related to that of the alternating current at the collector rings by a definite and practically constant ratio. A commutator e. m. f. of 100 volts requires an alternating e. m. f. of 70 to 80 volts, depending upon the wave form. A variation of the direct current voltage, therefore, requires a corresponding variation in the alternating current voltage supplied. This may be varied either by changes in the generator or in the transmission apparatus between generator and rotary, or it may be made by changes in the rotary itself, either increasing the field strength or otherwise.

(1) The voltage may be varied by varying the e. m. f. upon the generator, consequently increasing the e. m. f. throughout the system. This is in general applicable only when a generator supplies one rotary alone.

(2) The voltage may be varied by changes in the ratio of the windings of transformers which are placed between the generator and the rotary. This regulation may be done in one of several ways. (a) Loops may be brought out from the transformer for supplying voltages differing by steps of, say, 10 per cent. and the rotary before being started may be connected so that it receives one of these voltages, there being no provision for changing the voltage while the rotary is running. (b) The lowering transformer which supplies current to the rotary may be made with an adjustable or moving secondary, by which the relation between the primary and secondary coils is varied, effecting gradual changes in the e. m. f. delivered to the rotary. (c) The transformers may be provided with many loops connected to a switching device or controller, by which the e. m. f. of each phase can be raised or lowered by, say, 1 per cent. steps. In such a regulator the circuits may be arranged so that one circuit is switched at a time, the rotary being operated as single phase during the instant of switching over.

(3) An auxiliary machine may be placed on the shaft of the rotary or driven by a separate motor. This machine may be excited by the direct current from the rotary. Such an auxiliary generator or booster will have an e. m. f. dependent upon its field strength and may therefore be used for increasing the e. m. f. as the load increases. It may be wound for alternating current and increase the e. m. f. of the alternating circuit before it reaches the rotary, or it may be wound as a direct current machine and add to the e. m. f. delivered by the commutator of the rotary.

(4) The field strength of the rotary may be increased as the load increases by compounding it in the same way that an ordinary direct current machine is compounded. A low-field charge at light load will cause a lagging current to flow, which will cause a drop in e. m. f. if there be self-induction in the circuit. If the field current be increased the lagging current will become less and the drop will become less. A strong field will increase the e. m. f. at the alternating current end of the rotary, above that which the circuit would otherwise deliver. This e. m. f. may be kept the same at full load as it is at no-load, or may be made to increase so that the alternating e. m. f. at the rotary is greater at full load than at no load. In this method of operating the current to the motor is usually a lagging or a leading current and involves a power factor less than unity.

(5) In the induction rotary in which there is no direct current field charge the brushes may be given a backward lead so that the direct current flowing in the armature replaces in magnetizing effect a portion of the lagging alternating current which magnetizes the machine at no load, and therefore reduces the amount of lagging current supplied to the machine. This causes a less drop in generator and transmission circuits, so that there may be an increasing e. m. f. between no load and full load.

ELECTRIC FURNACES.—II.

BY LIEUT. F. J. PATTEN.

IT was discovered very early in the art that this problem, like all others in electricity, had two independent solutions, one on the lines of the arc to which alone reference

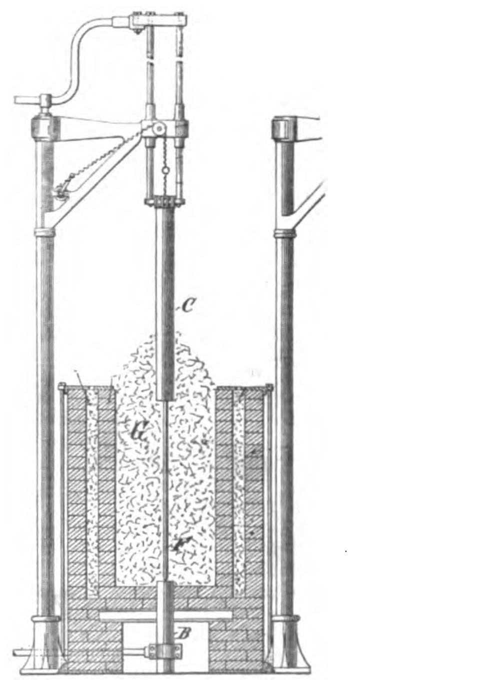


FIG. 7.

has thus far been made, and the other upon an incandescent system or method. In Dr. Borchers' recent work, "Die Elek-

trometallurgie," which is a complete epitome of the art from its beginning, he shows a number of electric furnaces built upon the incandescent plan, dating back into the eighties and early nineties; nevertheless, we find such a system patented in the United States as new in principle as late as 1896, but it may be well to add that Dr. Borchers' work had not appeared at the date of issue of the patent. Such a system is shown in Fig. 7, and is certainly as beautiful as it is simple in operation.

The two main electrodes, C and B, are united by a slender pencil of carbon, F, which is entirely embedded in the contents of the furnace, G, which it is intended to treat. When a sufficiently heavy current is turned on, this slender carbon

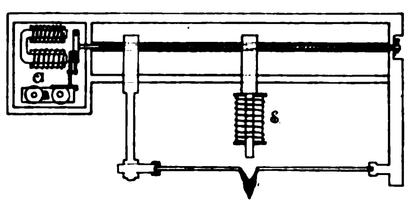
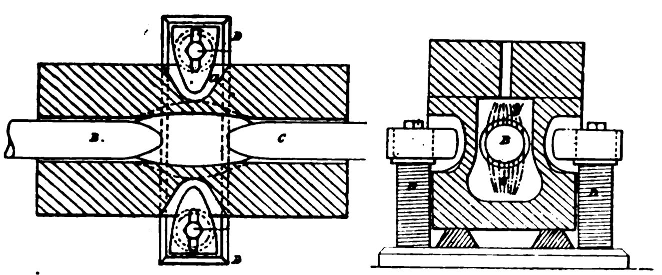


Fig. 8.

pencil is fused; but it seems that the temperature of fusing carbon is sufficiently high to determine the union of the carbon and calcium of the lime and coke mixture. Thus a slender pencil of calcium carbide is formed where the carbon pencil first was; this increases gradually in size until the resistance becoming too low the upper carbon is lifted gradually further away from the lower one, and in this manner the carbide nugget is both elongated and enlarged. The method is ingenious and does away entirely with the arc and its terribly roaring noise. The indications are that the incandescent method is more economical of power than the arc; there is certainly every reason that it should be so, and if tests upon a large scale show this to be the fact the arc furnace for commercial work will be a thing of the past. Further reference will be made to this system later, indicating a way to greatly increase the output of a single operation on the incandescent plan.

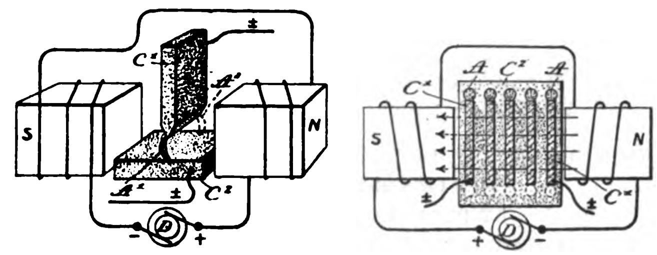
Early in the state of the art the idea of deflecting and fixing the position of the working arc by placing it in a magnetic field was availed of; Dr. Borchers, I believe, gives credit for first doing this to Dr. Zerener, of Berlin. His apparatus is shown in Fig. 8, and the patent bears date of 1889. The arc is sprung at D, between the two carbon electrodes, and imme-



Figs, 9 and 10.

diately over the arcing space a powerful electromagnet, E, is suspended. Its magnetism, according to well known principles, causes the arc to take the position shown, in which it will be held as long as the magnetic field is unchanged in direction. I find, however, a German patent showing the same thing applied to a furnace, and which antedates even Zerener's description by two years. It is a German patent granted to three Englishmen—Rogerson, Statter and Stevenson—in 1877, the two principal drawings of which are here reproduced in Figs. 9 and 10. Fig. 10 is a plan view looking down upon the furnace and Fig. 10 is an end elevation. B and C are the carbon electrodes projecting into the furnace, between which the arc is established; D, D, is a powerful electromagnet, the poles of which are brought as close to the arc as possible. The arc is, therefore, established in a strong magnetic field and is deflected vertically upward or downward according to the polarity of the magnet, the latter serving to diffuse the arc and prevent it from merely working at a central point between electrodes. In all these cases the arc is fixed in position, being diffused somewhat and deflected to a certain position, where it is permanently held.

In view of the fact that the idea of using a magnetic field for determining and fixing the arc in position is so old, it is more than strange that the same agency should not have been applied to move the arc from place to place, or to give it a reciprocating "or rotary motion." It is believed that this was first accomplished by the writer and the principle gives rise to an entirely new system of electric furnace operation involving the use of reciprocating or sliding arcs, rotating arcs, and in the incandescent line a rotating or revolving current incan-



Figs. 11 and 12.

descent system of furnace operation through use of which the power expended is made to do a maximum of work. The reciprocating or sliding arc furnace system is illustrated in Figs. 11, 12 and 13, the former indicating the principle of operation and the latter being the section of a furnace of this description.

In Fig. 11, C' represents an upright slab of carbon placed at arcing distance from the horizontal carbon slab, C², and N S are the poles of an electromagnet, so placed that the arc between the electrodes is normally in the field of the magnet

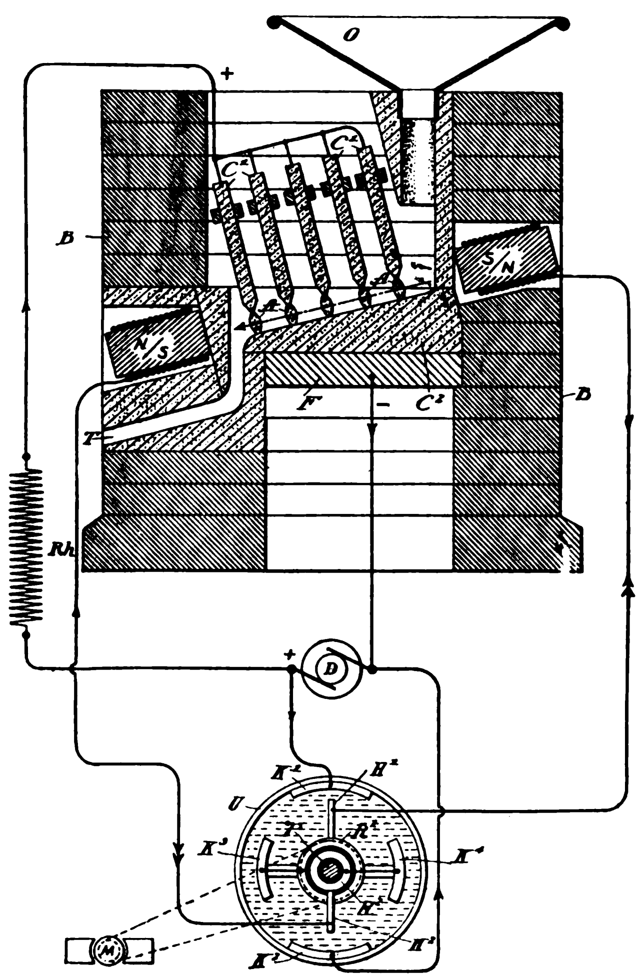


Fig. 13.

of which the lines of force flow from N to S, then the arc between carbons will assume a position dependent upon the direction of current flow and the lines of force. Thus, if the lines of force have the direction N to S and the current flows from the upper to the lower carbon, then the arc will assume the position A' at the left-hand corner of the upright carbon slab. Now, if either the current should change direction or the magnetic field should reverse, then in either case the arc would pass over to the right-hand edge or corner of the

upper carbon slab, assuming the position A'. In these physical conditions, therefore, lies the possibility of moving the arc to and fro across the edge of the upper carbon slab.

Fig. 12 shows an arrangement of a number of upright parallel electrodes placed in juxtaposition to a carbon slab forming the other electrode. The several arcs in such case between upper and lower electrodes traverse back and forth from side to side of the upper carbon with each alternation of current, and material passed between the upper and lower carbons on the lower carbon slab is attacked by the electric arcs,, A A, in rapid succession as they vibrate to and fro over the passing material.

DESIGN, CONSTRUCTION, AND TEST OF A 1,250 WATT TRANSFORMER.[1]

BY PROF. HENRY S. CARHART

TWO of my students, Mr. Trevidick and Mr. Harrison, undertook, under my supervision, the design and construction of a transformer to determine how nearly theory dictates correct practice. They chose the core type instead of the shell chiefly for construction reasons, as the iron for the core type can be cut at the tinsmith's without a die. At the same time this type departs so widely from the common design that they were thrown more on their own resources.

In the core type the number of turns of wire is greater than in the shell type, if the copper and iron losses are to be nearly equal to each other. This is the condition for highest efficiency.

For high efficiency under a light load, the number of turns of copper must be increased. But this causes a larger drop in potential and so impairs the regulation.

Design.—Preliminary trials showed that the number of primary turns should not be less than 1,200 and the secondary

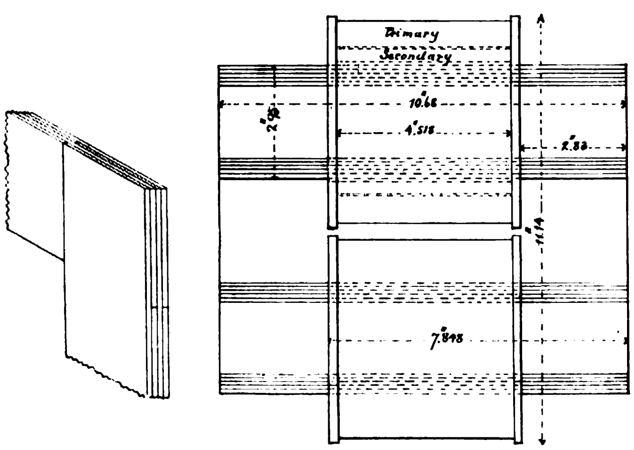


FIG. 1.

120 (or 60 in parallel). To determine the cross-section of the iron, it is easily shown that

$$A = \frac{E}{4.44\ nNB}, \text{ or, in this case, } A = \frac{1,010 \times 10^8}{4.44 \times 135 \times 1,200 \times 3,000}$$

= 46.8 sq. cm. = 7.25 sq. in.

Allowing 10 per cent. for oxide, the width of the core plate is 2.95 inches.

On the basis of 1,000 amperes per square inch, the primary was made of No. 17 d. c. c. wire and the secondary of No. 8. Winding the secondary in two layers of 30 turns each on each spool, the length of the core plates becomes 7.848 inches.

The estimated length of the secondary was 124.8 feet and its resistance at 40 degs. C., 0.0847 ohm. For the primary the length was 1,602.6 feet and its resistance 8.8 ohms.

The copper losses at full load are then 13.75 watts for the primary and 13.23 for the secondary. The hysteresis and eddy current losses were both combined under Steinmetz's formula with a hysteretic constant, 0.0025. The indicated iron loss was 39.11 watts in a volume of 193.27 cubic inches, and a flux density of 3,000 lines per sq. cm. Hence, the total estimated losses were 66.09 watts, and the efficiency 95 per cent.

The magnetizing current was computed by Thomson's formula as 0.048 ampere. The power component to supply the loss by hysteresis and eddy currents was 0.039. The total no load current is the resultant of these two in quadrature, or 0.061 ampere.

Construction.—Wheeling iron 15 mils thick was used for the core. It was carefully annealed out of contact with the air by heating in a furnace to 923 degs. C., and then slowly cooling. The above temperature is higher than the critical one at which iron ceases to be magnetic.

After winding and drying, the transformer was assembled by interlarding the end plates between those of the cores and compressing between ribbed clamps with the bolts through projecting ears.

Test.—The resistance of the primary at 40 degs. C. was found to be 8.46 ohms; that of the secondary, 0.083 ohm. The weight of the primary was about 9.25 pounds and of the secondary, 6 pounds. The iron loss, measured in the usual way by a Weston wattmeter, was found to be 34.5 watts.

The regulation was determined by a method of comparison by means of two voltmeters, and the voltage from no load to full load varied only 2.3 per cent. The cross-flux or magnetic leakage on full load was 2.65 per cent. The details of this measurement were given.

The following efficiencies were found by test: Load of 371 watts, 90.93 per cent.; 742 watts, 94.42; 1,020 watts, 95.12; 1,286 watts, 95.37; 1,475 watts, 95.43.

The comparison between observed and computed values is interesting.

	Observed.	Computed.
Resistance of primary at 40 degs. C.. ohms	8.46	8.80
Resistance of second'y at 40 degs. C....ohms	0.083	0.0847
Copper loss, primary, full load.......watts	14.07	13.75
Copper loss, secondary, full load.....watts	13.07	13.23
Iron losses ....watts	34.5	39.11
No load current ....amp.	0.05	0.061
Efficiency at full load............per cent.	95.4	95.

EXHIBITION OF INSTRUMENTS FOR DETERMINING THE FREQUENCY OF AN ALTERNATING CURRENT.[1]

BY GEORGE S. MOLER and FREDERICK BEDELL.

The instruments here included are two in number. The first one, which has already been described,[2] consists of a small synchronous motor brought to speed by a crank handle connected with the motor by a suitable train of gears. The apparatus contains an electrically operated counter, so arranged that its reading gives the exact value of the frequency of the alternating current with which the synchronous motor is supplied. The whole apparatus does not weigh over nine pounds. The reading is correct to within .05 of an alternation.

The second instrument consists of a sonometer or monochord. The alternating current flows through a piano wire mounted upon a sounding board. The wire passes between the poles of a permanent magnet. By means of a sliding bridge the period of the wire may be made equal to that of the alternating current. This is indicated by the vibration of the wire. A scale is arranged so that the position of the bridge indicates the frequency directly.

SHOULD LIGHTNING RODS BE INSULATED FROM THE BUILDING?

BY N. MONROE HOPKINS.

WHY do lightning rod men continue to erect insulated lightning rods when authorities on the subject agree that the uninsulated type is the correct one? The lightning rod men exercise the greatest care in keeping the rod from touching any portion of a building, and the electricians and writers of text-books who have studied the question prescribe that the rod should be in intimate contact with all the masses of metal about a building, such as the plumbing and metallic roof. In the case of the insulated rod protection is sought, by parrying the blow, so to speak, carrying the electricity to earth, while the theory of the connected type depends on a silent streaming of electricity between the cloud and building, equalizing quietly the tremendous difference of potential.

As is well known, in dealing with static electricity, a charged body will induce a charge of opposite sign in a body brought in proximity, and if the bodies are moved together, within "striking distance" a discharge, or spark, or series of sparks, will take place, neutralizing the two charges. Let us take the case of a positively charged cloud hanging over a building. The building will immediately become electrified negatively, the electricity being densest on or near the roof, the highest point. If this roof is metallic and directly connected to a network of rods carrying many sharpened points it will be seen by any one who has had anything to do with

[1]Read before the A. A. A. S., at Detroit. Abstract.

[1]Abstract of paper presented at the Detroit meeting of the A. A. A. S.
[2]See "A Synchronous Motor for determining the Frequency of an Alternating Current," by George S. Moler, Physical Review, March-April, 1897.

static electricity, that each point will "stream" or glow with a brush discharge until the tremendous difference of potential is neutralized and rendered harmless.

Of course, if the number of sharpened points are few, and the charge is a large one, the silent equalizing flow which drains the building, so to speak, of the dangerous accumulation, will be overtaxed and a flash will take place, with more or less mechanical disturbance.

It is the opinion of the writer that a building provided with stout rods, connected with all iron work, especially about the roof, having a great number of sharp projections, will be very secure from an actual lightning stroke, and should a flash ever take place between cloud and building, the mechanical disturbances will be far less in the case of the connected rod.

AGEING AND REFINING ALCOHOL ELECTRICALLY.

Mr. O. W. Swift, of New Haven, Conn., has designed an apparatus for electrically ageing alcohol—that is, eliminating the fusel or volatile oils, which constitute the most dangerous elements in alcohol liquors. Tests made by United States internal revenue officials demonstrate that liquors subjected to the Swift process undergo a very perceptible change, and take on the milder form of liquors mellowed by age.

LETTERS TO THE EDITOR

IRON CONDUITS AND THE UNDERWRITERS.

THE Suburban Underwriters, New York, have recently sent out a circular letter, accompanied by a copy of the latest rules and requirements of the National Board of Underwriters, and quotations from those rules are submitted below, as being probably as salient as any suggestions or rules among them:

RULES OF 1897.

General Suggestions.

"In all electric work conductors, however well insulated, should always be treated as bare, to the end that under no conditions, existing or likely to exist, can a grounding or short circuit occur, and so that all leakage from conductor to conductor, or between conductor and ground, may be reduced to the minimum."

Rule 14, Paragraph D.

"Bushings must be long enough, etc. The tube then is to have a non-conducting bushing pushed in at each end so as to keep the wire absolutely out of contact with the conducting pipe."

Rule 41, Paragraph J.

"Plain iron or steel pipes of equal thickness, etc., * * * may be used as conduits, provided their interior surfaces are smooth and free from burs * * * interior surfaces coated or enameled to prevent oxidization."

On the lines of discussion, as started by "Jim Crow" and "Doe Bird," relative to the use or non-use of plain iron conduits, I think that the National Board can hardly realize or appreciate just what their rules imply or permit, and this statement is made inasmuch as my acquaintance with the officials of the leading companies representing the National and other Boards in this locality convinces me that it is impossible that men who have made such a success of fire insurance, should now deliberately, and apparently with considerable exercise of care, issue rules and formulate suggestions, which, in and of themselves, are grossly inconsistent to even a novice in the methods of installing electric wires and appliances.

Your readers will note that under the "General Suggestions," given above, the underwriters desire that all conductors should always be treated as "bare"; and yet in their rules permission is granted for the use of "plain iron or steel pipe" for containing not only one conductor, but both conductors of a circuit! It may be asked, in all fairness, is this following out their own suggestion, and treating conductors as "bare"?

Again, in their rules, a portion of which has been quoted, wires in passing through brick walls "must be encased in an iron-armored conduit" and "no other method, etc., will be accepted"; and it is also noted in these latest rules, that tubes, where they pass through floors, if they are iron, must be supplied with a non-conducting bushing, "so as to keep the wire absolutely out of contact with the conducting pipe."

Now, in all seriousness (and it is indeed a serious subject, and one not to be lightly pushed aside), how can any body of men, professing to be experts, formulate a set of rules which are so contradictory as the rules of 1897, as is evidenced by the quotations which have been made from the copy sent, as well as from the letter of the Suburban Underwriters?

If it is considered a hazard to place a single conductor within a short piece of plain iron pipe where passing through a wall or floor, so that the insurance inspectors must insist upon the wire being protected from the "conducting pipe" by a non-conducting bushing, must it not of necessity be logically far more hazardous to place two conductors of a circuit within one "plain iron or steel pipe," and permit this throughout an entire installation?

They must certainly admit, if they are experienced and practical men, that the amount of trouble and consequent hazard must be greater where an entire installation is permitted in "plain iron or steel pipe" than in a case of a single wire passing through a short piece of "plain iron or steel pipe" in conjunction with brick walls or floor work.

"Jim Crow" has set forth in his letter another point which should have the attention of your readers, and, although it may not have been his intention to bring out the fact, it is true that under these rules, as well as under former rules of some of the associations, engineers, contractors and others may erect skeleton or solid iron or steel switchboards to which may be attached the usual appliances by the use of ordinary commercial forms of insulating materials. The rule as quoted reads: "Must be made of non-combustible material or hardwood in skeleton form, filled to prevent absorption of moisture."

In this connection it may be stated that one of the consulting engineers in this city suggested to a manufacturer of enameled apparatus that it would not be very long before certain classes of switchboards would be made completely of an iron or steel frame, and recommended to the manufacturer that he make provision for manufacturing skeleton frame work for switchboards, enameling the metal work, believing that time would eventually prove that such a board for low potential work would be permitted, and would be a cheaper form or construction, considering all the circumstances, than a marble one, and would outlive it beyond doubt.

Your readers will undoubtedly perceive that this engineer's recommendation was undoubtedly made in a spirit of bitter sarcasm, but he was undoubtedly well informed as to proposed new rules, as the inconsistencies of the latest rules prove; and it would not be surprising to the writer to actually hear of somebody making, or advising, an iron or steel frame switchboard, and quoting the National Board of Underwriters as an authority for such construction.

"Doe Bird" states that the main bone of contention is "simply as to which is the safer conduit for electrical conductors, insulated or uninsulated." I must differ from your correspondent, and offer criticisms on a different line at this time. I submit, that if "plain iron or steel pipes" are considered good and safe construction with both conductors of a circuit within them, then the insurance people certainly must, if they wish to be considered intelligent and fair-minded, permit the same class of construction as regards insulation, throughout any and all classes of work.

They cannot or should not expect to make suggestions treating conductors as "bare," formulate and distribute rules based upon such a suggestion and theory, conduct themselves throughout all the various forms of installation of wires and apparatus upon the theory of "bare" conductors, and then, with one sweep, wipe out all their rules and permit the use of conduits which under no circumstances, as evidenced by the various rules, and by the circular letter, can be treated as "bare."

If the underwriters are wise in their time, they will immediately withdraw their permit to use "plain iron or steel pipes," or else they will have to concede that their rules which allow other classes of installation are faulty, unjust and throw upon the engineer, contractor, and the owner a burden of expense which they have no right to ask of them. The insurance companies should also bear in mind the fact that the loss by fire is not paid by the insurance company, but by the premiums which come from the public, and consequently the public have just as much, if not more right, to dictate to the insurance companies what is proper and safe construction, as well as the insurance companies have to formulate and distribute rules and try to enforce them, when these rules are thoroughly inconsistent and cannot be lived up to.

BALD EAGLE.

New York City, August 11, 1897.

THE

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AMERICAN ELECTRIC RAILWAY EQUIPMENT ABROAD.

WHEN the Central London Railway a few weeks ago gave its order for car, locomotive and electrical equipment to American manufacturers there was a considerable undercurrent of ill feeling noticeable in the comments of the English daily press, which took the stand that these orders ought to have gone to English firms. It is a satisfaction to note, however, that no such grumbling was manifested on the part of the English technical, electrical press. The reasons which dictated the giving of the order to America are well put in a recent interview with the secretary of the Central London Railway, published in the "Railway News," of London. That gentleman states that his company was influenced by the advice of the best electrical experts, who stated that the more extensive use of electric traction in the United States had brought the manufacture of plant and material to a higher pitch of perfection and to a much lower cost than they could be got at in England. Our tools and manufacturing machinery were much in advance of theirs, as was to be expected when the small amount of electrical traction construction in England is considered; and as it was the desire to equip the line in the very latest and the best manner, no recourse was left but to go to America for the material. This tells the story in a nutshell. American electric railway apparatus goes to England for the same reason that smaller American machine tools find a profitable market there. It represents, as do the latter, a product peculiar to American skill and experience, and as long as we keep in the van with these manufactures we will probably find a market for our goods. It must be apparent, however, that as time passes the English manufacturers will gain that experience which is now our particularly valuable stock in trade and that we cannot always hope to secure such sweeping orders as that for the Central London Railway equipment. But by keeping in advance we may still hope to stave off that day for some time to come. If England does not go extensively into electric railroading, her market for such electrical apparatus will be ours. Should she develop a large electric railway industry, she will certainly manufacture herself the supplies necessary. The present situation reflects on her slowness in making the change from horses and steam, and not on the ability of her electrical engineers and manufacturers.

THE X-RAY IN MEDICO-LEGAL QUESTIONS.

THE X-ray has already secured for itself a permanent place in the diagnosis of disease and in surgery, and has frequently been employed in medical-legal work to demonstrate before courts the existence of fractures or dislocations of bones. In a recent case, however, reported from Elmira, N. Y., counsel for an alleged murderer took the position that the victim met his death not by the bullet fired into his brain, but by the X-ray which was employed to locate the bullet. As no previous case of death from the X-ray has been reported, the ingenious plea of the prisoner's counsel will hardly be likely to have the desired effect on the jury. Still, the incident is worthy of note, as it emphasizes the fact that if the X-ray is not to fall into bad odor with the public and the courts, physicians and X-ray photographers generally will have to exercise the greatest care to prevent even the comparatively slight skin affections which have resulted from the injudicious use of the X-ray in the past. Apropos of this, attention is again called by Mr. Tesla to the precautions desirable in making X-ray photographs, and in an article which we print elsewhere in this issue he describes some new forms of X-ray tubes designed especially to avoid the evil effects noted in the past. Mr. Edison, who was probably the first to point out the ill effects of the ray, regards the dangers as being absurdly exaggerated.

LORD KELVIN.

IT is some thirteen years, we believe, since Lord Kelvin visited this country last, the occasion being the British Association meeting at Montreal and the Electrical Conference and Exposition at Philadelphia, in 1884. The arts of applied electricity have greatly grown in this country in the interval, and our distinguished visitor will doubtless find much to interest and please him. The same period has, however, witnessed the steady growth of Lord Kelvin's own work and the firmer establishment of his own great fame and reputation; and American electricians are glad to extend to him hearty congratulations not only upon his long years of high public service as physicist and inventor, but upon the honors that of late have been poured upon him. With this official recognition of Lord Kelvin's work goes a recognition of electrical advance, and the honors are such, therefore, as we can all share in. And what we say of the welcome now accorded Lord Kelvin here, applies equally to the other well known leaders in electrical science and application who attend the British Association meeting at Toronto this week. We American electrical engineers are all delighted to see our brethren from across the sea and trust that their stay may be prolonged.

THE MARCONI WIRELESS TELEGRAPH AS A COMMERCIAL INSTITUTION.

WIRELESS telegraphy has reached the commercial stage in London to the extent of a capitalization of the Marconi system in the sum of £100,000 in what the London "Electrician" calls "handy £1 shares." With the air of the Scotchman contemplating the marriage feast vessel in St. Ursula's our careful contemporary concedes that Signor Marconi's system "may" have some original features; but it has its doubts, and after dividing the poor fellow's substance between Maxwell, Hertz, Branly and Lodge, it inquires pessimistically of what commercial use is wireless telegraphy going to be anyway? We are loth to add to the decimating criticism of our friends over the water upon this organization of "Earth Wobbling" elements, and feeling sure that the "handy £1 shares" were snapped up long before the "Electrician's" frosty radiations reached the pocket coherer of the British investor, we would point out that the financial editor in Salisbury Court, E. C., overlooked one very important prop upon which Signor Marconi's edifice of borrowed equations, telepathized experiments, kodaked radiations and long range coherency seems to rest, viz., the "tapper" for shaking the powder in the coherer, so as to de-cohere it after a signal current has caused it to cohere. Without this shaking up the receiver would keep the local circuit closed, or cause it to "stick." In his American patent just issued all of Signor Marconi's fifty-six claims include the combination of "a means for shaking the powder" or contact of the receiver. Now it appears that at about the beginning of Hertz's experiments the advantages of communicating vibrations to a telegraph receiver for the purpose of preventing cohesion of the contacts were discovered by another inventor, as disclosed in British patent No. 21,629, 1893, for improvements in cable and submarine telegraphy, issued to Delany. It shows a vibrator "for preventing sticking or adherence of the movable contact arm of the main receiver or relay to its contacts, from any cause whatever." . . . "When the main line current ceases, the vibration prevents any welding or other bond of cohesion between the contacts." . . . "These freeing vibrations may be created in any suitable way, electrical, mechanical or otherwise, and, of course, may be applied to a receiver in a main line current, a local circuit, or to the contact or limits of any delicately actuated arm of telegraphic receiving instruments." Still, if Signor Marconi can organize Maxwell's equations, Hertz's experiments, Branly's radiator, Lodge's coherer and

Delany's agitator so as to find St. Paul's from the Eiffel tower in a London fog, he is a great man, and we predict that the "handy £1 shares" will command a premium calculated to fill skeptics with chagrin. Only last week we printed the text of the original, modest little circular issued by Messrs. Hubbard and Watson as to the use of the telephone, twenty years ago when few people could see any use for it and when the stock went begging. Various uses have already been suggested for the wireless telegraph, and reading now of the cut wires of the British troops on the Afghan borderland and their dependence on heliographs liable to be obscured any moment by smoke, accidental or intentional, we could not but think that "scientific frontiers" might well be strengthened by wireless telegraphs.

WHEN IS A STREET RAILROAD NOT A STREET RAILROAD?

THIS rather perplexing question has just been decided in Ohio by Judge Neilan in an action brought against the Miami Valley Traction Company, by steam railroad rivals, to prevent it from building its line from Hamilton, Ohio, out through Warren County. Various grounds of objection were raised against the right of the County Commissioners to grant an absolute right of way on highways to a street railway carrying passengers, freight, mail and express. The court first of all found nothing unconstitutional in the law under which the commissioners had granted right of way, and then justified their action as well within the scope of its provisions. It saw nothing wrong in a longitudinal occupation for public service of a part of the highway, and did not consider the use of the term "electric street railways" as in any wise a restriction. We think the court was justified in refusing to sanction a narrow interpretation of the word "street" and in declining to limit transportation on "streets" or highways to horses because no better means was known in days gone by. In this case the track is at the side of the road and conforms with it in grade, so that the entire highway can still be used except as the car is passing. Moreover, as population will at once grow up along the highway, it will become more of a "street" than ever. Turning to the matter of freight, etc., the court remarked: "To say that it is constitutional for a farmer or his wife to ride to the nearest market town, but it is unconstitutional for him to take a quarter of beef, or his wife to take a basket of eggs, or a roll of butter to market; or, if instead of going themselves, they send those articles on this railroad—is it seems to the court an absurdity." The judge went on to say also that even if the farmer hitched a motor car to his wagon of wheat, instead of hauling it along the highway with a team of horses, it would not be unconstitutional, but "the very purpose" for which the highway was first laid out. So think we, feeling at the same time that this decision is but another sign of the profound changes going on in old-fashioned ideas as to what was a railroad, or street railroad, and what was not. This decision is certainly one of great interest to contractors and to security holders in general, and deserves note by all engaged in railway work.

MR. MOORE AND HIS CRITIC.

IN its last issue the "Electrical Review" returns to the attack on Mr. Moore's system of vacuum tube lighting, and continues its criticisms of the articles which have appeared in The Electrical Engineer descriptive of Mr. Moore's system. It ends up by asserting that even if Mr. Moore's system should prove successful there would be nothing new in it. So far as the criticisms on The Electrical Engineer's statements are concerned, we stand by every word we have thus far printed. Where figures were given they were based on facts, and as for the rest, our aim has been to treat Mr. Moore fairly and to give him, as we would any other struggling inventor, such encouragement as lay in our power,—a course which we shall continue to pursue. As to the novelty of Mr. Moore's devices, that is a question which we have never raised, nor have we investigated it as patent experts in the slightest degree. All we know is that the world has for some time past been seeking a cold, white light and that Mr. Moore notably is trying to give it what it wants. Whether his means are old or new is of no consequence to us whatever; we are perfectly well satisfied to let Mr. Moore himself take care of that part of the question. The very fact that our contemporary has been compelled to avail itself of this argument indicates the weakness of the stand it has taken in this controversy. In its last utterances, moreover, our contemporary has, we are sorry to note, introduced remarks quite as irrelevant to the real question, as though a public speaker were interrupted with criticisms of his height or the fit of his clothes. Such offensive and vulgar personalities in debate are usually intended to close a discussion forcibly or compel its continuance on similar lines of objurgation. In this case, if such be the intention of our esteemed contemporary, we must decline to discuss the merits of any invention on the basis of our own or any other journal's circulation. If our contemporary had no such intention of befogging the issue, we beg to assure it of our highest consideration.

WASTED CURRENT IN ARC LAMPS.

EVER since arc lamps have been run on constant potential circuits, the practice has been open to the just criticism that it involved an appreciable loss of energy consumed in the resistance invariably accompanying the lamp. This resistance was necessary to make up for the difference in potential between the lamp terminals and that of the feeding circuit, as well as to "steady" the arc. Even with two ordinary arc lamps in series, an appreciable percentage of the current is wasted, and even the high voltage enclosed arc does not overcome the difficulty. Allowing a loss of, say, 25 per cent. of the energy supplied to the lamps, it is apparent that an installation of only a dozen arc lamps means a decided loss of energy. To prevent this constant loss it was proposed some five years ago by Prof. Heim to substitute low voltage incandescent lamps for the dead resistance, and at least one installation of this kind was carried out in Berlin. We are not informed whether this plant worked satisfactorily or not, but the chances are that it did not, for the obvious reason that the fluctuations of potential at the terminals of even the best arc lamps would be fatal to the life of the incandescent lamps in the same circuit, or, at any rate, would cause such marked fluctuation in candle-power as to make them unserviceable. The economical Germans are apparently still bent on preventing this loss, for we note in a German contemporary an article in which the writer proposes to absorb the wasted energy by charging storage batteries from which incandescent lamps, or electric heating devices, or fans can be fed at any desired time of the day. There is apparently nothing impossible in the carrying out of this suggestion, and it might be worth a trial where a large number of arc lamps are connected to incandescent circuits. There is, however, one doubtful point which suggests itself in this connection, and that is whether the arc lamps themselves will work properly under the conditions assumed. As is well known, arc lamps on constant potential circuits require a "steadying" resistance, and it would remain to be seen whether the counter e. m. f. of the storage battery would act in the same way as a dead resistance so far as the arc is concerned. We must confess to some doubts on this score. Nevertheless, the matter of the wasted energy in constant potential arc lamps is well worth further study, now that the enclosed arc has given that type of lamp another decided impetus.

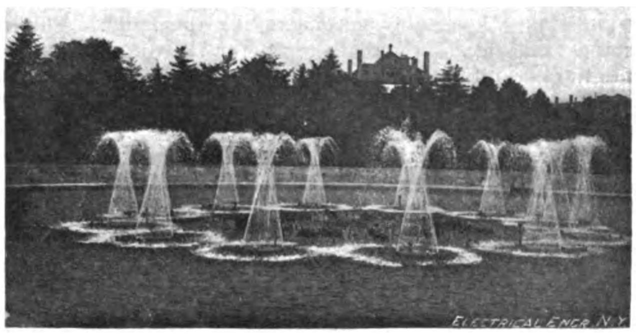
CLOSING A CHICAGO MUNICIPAL SHOP.

CHICAGO has of late been, as a city, under the necessity of saving money wherever possible, and hence a great many old leaks are being stopped. If the city would go out of industrial business altogether it would probably be able to reduce taxes materially, but that is hoping for too much. We are pleased to note, however, that Mr. E. B. Ellicott, the new city electrician, has taken one bull by the horns in closing the city electrical repair shop, after receiving a report from the foreman, which at once convinced him that "a large sum of money could be saved by closing the repair shop and having the repair work of the department done under contract." If Mr. Ellicott would follow this out logically, and take the city out of the electric lighting business, he would save still more money and add further lustre to Mayor Harrison's administration. It is rarely that one strikes such a frank admission of the expensiveness of municipal ownership. Within the past week, three reports as to city plants have passed through our hands, in each of which a large sum of money is called for to extend the plant, so that it can be made satisfactory and meet the demands on it. Yet when the original plants were put in, the tune was very different. Each plant was going to pay for itself in a year or two and provide for extensions out of the profits. But municipal plants in reality don't work that way.

ELECTRIC LIGHTING

THE ELECTRIC FOUNTAIN AT THE PROSPECT PARK PLAZA, BROOKLYN, N. Y.

ANOTHER electric fountain has been added to the list which already is becoming a long one, of such installations in this country. In its issue of May 26 last The Electrical Engineer gave some details as to the fountain proposed for the plaza outside the main entrance to Prospect Park.



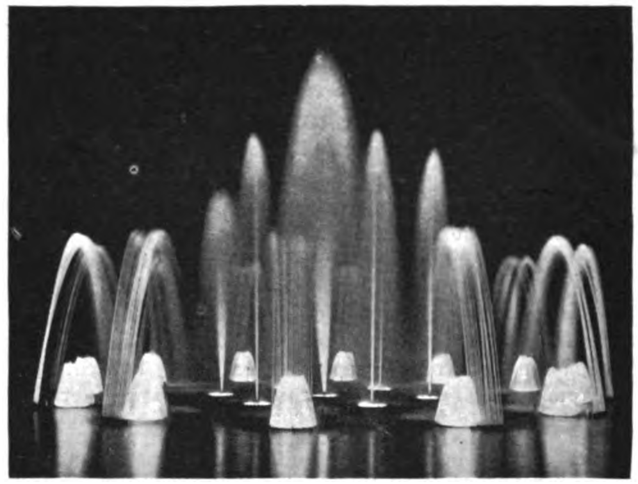
DAY EFFECT, BROOKLYN ELECTRIC FOUNTAIN.

Brooklyn, and it was stated that the work had been entrusted to Mr. F. W. Darlington, the consulting electrical engineer, of Philadelphia. The plans have now been successfully carried out, and a few details may, therefore, be given of the operation of the plant.

The Prospect Park fountain stands in the center of the plaza, and its jets rise at the point where the center lines

BIRD'S-EYE VIEW OF THE ELECTRIC FOUNTAIN, PROSPECT PARK PLAZA, BROOKLYN, N. Y.

meet of the two great converging avenues which lead to that part of the park. At this same spot there stood for thirty years or so a fountain built by C. C. Martin, the present Chief Engineer of the Brooklyn Bridge, but that fountain was one of the high cascade style and would have obscured the view of the new white arch and decorative columns which now mark this entrance to the park. All of the old fountain has been removed and the pool for the new fountain now lies almost level with the curb. No part of it interferes with the view as one approaches the plaza, as shown in one of the engravings herewith. The arch and the columns back of it can be seen for half a mile down these avenues, and when the new fountain plays its waters will be seen with these noble features for a background. Simple grass plots border the new fountain, and all around on three sides the ground rises



ONE OF THE EFFECTS, BROOKLYN FOUNTAIN.

from it, so that tens of thousands of persons are able to view it as in an amphitheater.

The pool lies within a broad sidewalk and about its immediate edge there is nothing but an ogee moulding of granite which rises less than two feet above the level of the walk. The basin is a perfect circle, 120 feet in diameter. One of our illustrations shows its position. Within the walls drop straight down about four feet and from the edges the bottom slopes away gradually, leaving the waters shallow at the edges. When the water is at the full height only a few nozzles rise above it near the center.

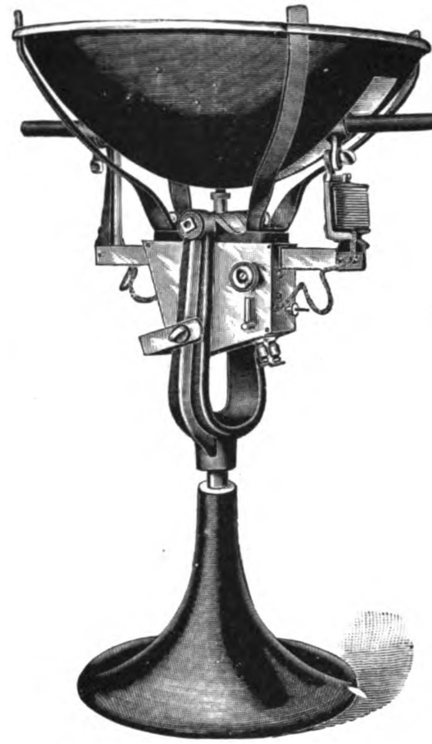
At the side of the basin nearest to the avenues is a gateway. Through this a part of the waters are let out when the more intricate effects are to be produced. When the waters are lowered six inches or so, the pipes and

jets are disclosed. The main features of these are nineteen glass-topped funnels, or holophotes, which rise even with the surrounding waters. It is through these that the colored lights are projected from a working chamber below. These funnels are arranged in two concentric circles, with one holophote in the exact center of the fountain. In the first circle are six funnels and in the second are twelve. From the center of this middle funnel rises a pipe with a 1½-inch nozzle, which projects a central geyser jet high in the air. Around the edge of this funnel are seventeen smaller jets. In straight lines one on each side of this funnel are jets which throw up fans of water, and running around in circles, one just within and the other just outside the first circle of funnels, are many jets, which project circular walls of spray over that line of funnels. Each one of the six funnels of the inside circle has a center jet, throwing an inch stream, and each of these funnels has also two lines of small jets surrounding it. Between these funnels are straight lines of small jets, rayed out from the center of the fountain, forming a six-pointed star. In each of these lines there are forty jets. Twenty of these throw their streams to the right and twenty to the left, bringing their waters over the lights that will stream upward from the funnels. Each of the twelve funnels of the outer row has a fringe of seventy-four jets, which form sheaves of water, and lying just within this outer circle of funnels are twelve large pipes which project fancy streams of four different kinds arranged alternately around the circle. Three of these form umbrellas of water, three throw up fountains of rose spray, three are whirling jets, and three are ball nozzles, which make

ONE OF THE EFFECTS, BROOKLYN FOUNTAIN.

globular showers of water. Twelve more nozzles, each ¾ of an inch in diameter, lie just outside these outer funnels, and these throw up solid streams, which lean inward toward the center geyser. Outside of these, and forming the extreme circle of jets, are twelve straight lines of tiny nozzles, each of which throws up sixteen streams of water in straight ribbons. These ribbons also lean inward, so as to bring their waters over the funnels of light, and when they are playing toward the central geyser, and each is illuminated in different colors, the effect resembles a May pole with its variegated ribbons. Altogether there are nearly 2,000 jets in the fountain, and when all of them are in use it is estimated that it will take 100,000 gallons of water an hour to operate them. A row of white electric lights around the inside wall of the basin will illuminate the waters at ordinary times.

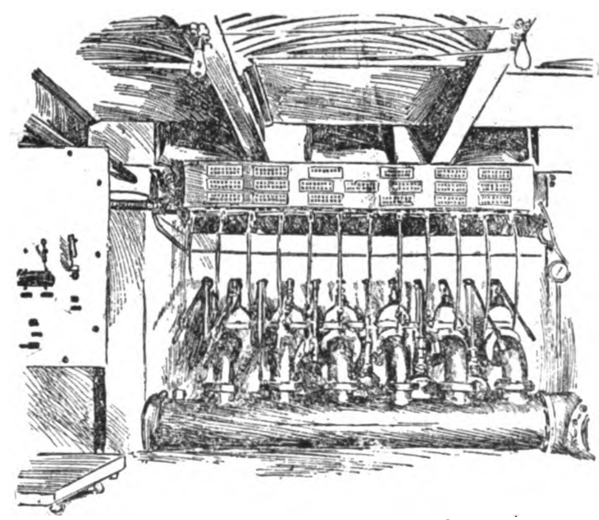
Under the basin and under the grass plot between it and the arch is the operating mechanism. A dozen pipes lead from the adjacent city water tower and reservoir to the fountain work in the center. Two of these pipes are only two inches in diameter, but the other ten are each six inches in diameter. The central display is divided into twelve distinct parts, and each of these is supplied with water from one of these pipes, and the water for each is controlled by a valve in the operating chamber. In the side of the basin next the arch are three glass windows. The operator who controls the jets and the colored lights stands underground in front of those windows and plays the fountain. The operating chamber lies directly under the center of the basin. It is octagon in shape and is forty-five feet across. Its roof is upheld by steel beams and columns and is formed of arches of corrugated steel, cement and asphalt. Through this roof run the nineteen holophotes, each 22 inches in diameter, and covered with plate glass. Under each funnel stands a powerful electric searchlight, fed by the 500-volt current of the trolley



ARC PROJECTOR UNDER FOUNTAIN.

wires. Hung from the ceiling, beside each funnel is a rack of eight round steel frames, each of which contains a colored glass the size of the funnel. In these frames are glasses of the seven colors of the rainbow and one of black. Attached to an arm on each frame is a lever which runs to an air cylinder, and the arms are operated by an automatic electric air compressor. Electric wires run to valves on each of these cylinders, and the pushing of buttons in the operating room lets the air into the cylinders or out again and so swings the discs of colored glass between the searchlights and the funnels or back again.

One man attends to the searchlights, and the only other per-



OPERATING ROOM, BROOKLYN PLAZA FOUNTAIN.

son needed is the operator. Where he stands looking out of his windows he faces a row of twelve levers, each of which controls the water to one set of the fountain jets. In front of him is also a long board, on which are arranged nineteen sets of push buttons—one set for each funnel. There are two rows of eight push buttons in each set. The upper row has each button colored to match the colored glass disc which it con-

trols. Those in the lower row are all white. When the operator touches a colored button, the disc of that color is turned over the searchlight. When he touches the white button beneath the disc is turned back again.

Behind the operator is a pit prepared for an electric pump, which will eventually be put in to furnish a much higher pressure for the fountain than can be got from the city mains, and to use the water over and over again. This pump will cost about $5,000, and no appropr'ation has yet been made for it. When it is in use the water can be sent to the fountain at a pressure of 150 pounds to the inch, instead of the 30 pounds now available.

The contract price for the fountain was $24,500. The current on the fountain is supplied free by the Nassau and Brooklyn Heights trolley companies, which have tapped their 500-volt trolley mains for the purpose. At the present time the fountain is illuminated on Wednesday and Saturday nights, when, of course, the roads benefit in turn by the large crowds of spectators attracted to the plaza by the brilliant spectacle.

The arc lamps used under the fountain in Brooklyn to illuminate the jets of water were made by J. B. Colt & Co., and are similar to theater projection lamps with the exception of being arranged to carry a heavy current of 40 amperes instead of 20. The insulation of all parts of the lamps is much heavier, as it has to stand 500 volts with the return wire grounded. All the insulation is thick sheets of mica, and no part of the lamp is connected with the current except the short carbon holders, not even the racks that support the holders. To still further insulate the lamps the heavy iron bases are supported on boards which in turn stand upon insulators. The type of lamp is shown herewith. Six lamps are run in series, there being three circuits, one of which has seven lamps in series, making in all nineteen lamps. Each lamp takes 45 volts; therefore, six lamps take 270 volts, leaving 230 volts surplus, which is taken up in an adjustable rheostat, this latter regulating the current, so that if the voltage of the mains drops to 300 volts the rheostat is nearly all cut out and the lamps are not reduced in brilliancy.

A strong spring movement brings the carbons together in each lamp, the regulation being performed by a shunt magnet. Under these conditions the lamps feed as well on 15 or 20 amperes as on 40. The reflectors used are polished metal parabolic reflectors, 20 inches in diameter. The beams of light have been so arranged by Mr. E. P. Hopkins, electrician for J. B. Colt & Co., as to form a very high cone of light, each beam being slightly inclined toward the center, and in this way follows the jet of water. In order to obtain a steady light from carbons in a horizontal position, the regulation must be very sensitive and feed often, but slowly, producing almost a continuous feed, but at the same time it must rest for some time, in order to burn off the lower edge of the carbon, or any "mushrooms" that sometimes form, from apparently no cause whatever. The shunt regulation of these lamps accomplishes this very successfully.

As already stated, the fountain has been designed and built by Mr. F. W. Darlington, the work of actual construction being done by the Wilson & Baillie Manufacturing Co., for whom Mr. J. W. Wilson is the electrical engineer. Mr. C. C. Martin has acted as the consulting engineer for the city. The structural ironwork and piping was furnished by Benjamin F. Shaw Company, and the air tank, etc., by the Hunt Air Brake Company; the air valve control mechanism being made by the Cleverly Electrical Works, of Philadelphia. As already noted above, the lamps are those of J. B. Colt & Co. The switchboard is of white marble, with knife switches, and Weston indicating instruments.

ELECTRIC LIGHTING AND GAS CONSOLIDATION IN NEW JERSEY.

The People's Electric Light and Power Company and the Newark Gas Company, each having a capital of $5,000,000, and controlling most of the lighting interests in Essex, Hudson, Bergen, Passaic and Union counties, have perfected a plan of consolidation, with a capital of $15,000,000. The United Gas Improvement Company, of Philadelphia, which controls many of the gas and electric light and power companies of South Jersey, is interested in the deal. Some of the promoters admit that the connection of the latter concern means the ultimate consolidation of many of the gas and electric power companies of the State, with an aggregate capitalization of $50,000,000.

VICTORIA, TEX.—The Victoria Light, Power and Ice Company, which has a Westinghouse alternating plant, is in the market for a high speed engine of from 100 to 125 h. p. Mr. L. L. Stephenson is the manager and superintendent.

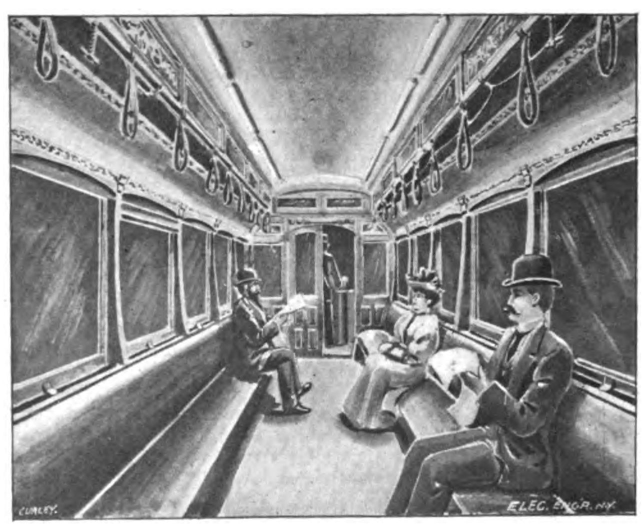
MOORE VACUUM TUBES FOR STREET AND CAR LIGHTING.

IN the accounts we have given up to the present of Mr. D. McFarlan Moore's system of vacuum tube lighting, the tubes were employed for interior illumination. Looking toward the future, however, Mr. Moore has recently tried some experiments in outdoor vacuum tube illumination, which lead him to the belief that such work is in every way practicable.

Street Lighting by Vacuum Tubes from Railway Circuits.

In a recent out-of-door experiment of this kind, it was found that with the light of only one tube the seconds' hand of a watch could be read at a distance of 60 feet. The tube in question was similar to those Mr. Moore has used in previous experiments, being about 7 feet long and 2 inches in diameter. In this case the upper half of the tube was painted white, so as to act as a reflector, with the result that the light was cast downward affording an absolutely uniform distribution.

Mr. Moore believes that the streets through which electric railway lines pass present special facilities for carrying out



Street Car Lighting by Vacuum Tubes.

such a plan of illumination. The tubes could be strung between the poles in the manner illustrated in the accompanying engraving, Fig. 1, the current being derived from the railway circuits. Though the engraving is only intended as a fancy sketch, Mr. Moore is so thoroughly impressed with the feasibility of the plan that he has actually worked out many of the details to insure continuous operation under all conditions of weather. He has already determined the fact that water on the tube interferes in no way with its action.

For electric car lighting Mr. Moore also believes his system well adapted. Besides lighting the interior in the manner shown in the sketch, Fig. 2, the names of the streets can be outlined on front and sides of the car, so that colored signal lights will no longer be necessary.

THE ZAMEL ARC LIGHT METER.

THE Zamel Arc Light Meter Company, 266 Blue Island avenue, Chicago, have just brought out a new device for the purpose of timing the use of arc lights. They claim their device to be reliable in every way, and that it will positively start the clock movement whenever the current is turned into the meter and lamps, and will also stop the clock when the current is turned off.

Central stations may derive benefit by the adoption of this meter in various ways by having the customer turn the light on or off as it is needed, thereby saving the salary of a man to patrol circuits to shut off 10 o'clock or other earlier lights; they are also enabled to place new contracts with parties who

THE ZAMEL ARC LIGHT METER.

would not go on a monthly schedule. The manufacturers say that this meter or timer has been tested by several companies and found to operate in a perfectly reliable manner.

The meter is a simple device, consisting of a balance wheel on a shaft on which is also placed a toothed lever which works a cogwheel that serves to start and stop the clockwork movement which registers the length of time during which the arc lights are being used. The front of the instrument has a face similar to a clock's on which are shown the number of hours that the lights are in operation. All parts of the instrument are mounted on slate and perfectly insulated.

The clock will indicate 144 hours. The hand on large dial measures up to twelve hours and shows quarter hours. Each number on the small dial represents one round of the large dial, or twelve hours; one revolution of the small dial indicates 144 hours.

LIGHTING CIRCUITS—LIGHTNING CONDUCTORS.

BY BINGHAM WOOD.

IN many cases the introduction of electric lighting into buildings has been followed by an increase of the insurance rate. The following incident will go to show that lighting wires are in some cases a protection rather than a risk in buildings.

During a heavy electrical storm some days since, the largest hall that the town of Egg Harbor City, N. J., can boast of was struck by lighting and the only apparent effect was the lights all going out.

Directly over the stage, which is stocked with a large quantity of inflammable material in the shape of scenery and other property effects, is a square tower surmounted by a flagpole. In this tower is placed the converter supplying the building with current.

The bolt struck the flagpole and followed down to one of the rafters, completely shattering it. From here it glanced over to the converter, through it to the line and ground through the arresters.

As the building is entirely of wood and has no pipes or other ironwork in it, and is not protected by lightning rods, it is fair to suppose that but for the presence of this converter the bolt would have taken a direct course to the ground through the stage, and would in all probability have ignited some of the scenery, and there would have been no possible chance of saving the building.

ENLARGEMENT OF NIAGARA HYDRAULIC POWER PLANT.

Three important contracts have been awarded by the Niagara Falls Hydraulic Power and Manufacturing Company in connection with the enlargement of its big power house below the bank. The contracts were for the structural steel for the interior of the power house extension and involve a large sum in the cost of its manufacture. The contracts awarded are as follows:

Structural steel work, the Variety Iron Company, of Cleveland; for all valves required, R. D. Wood & Co., of Philadelphia; the penstock, Struthers, Wells & Co., of Warren, Pa. The penstock which will supply the water for the additional turbines and dynamos will be 15 feet in diameter and 300 feet long. It is to be one of the largest penstocks ever built, and will weigh 300 tons complete. The capacity of the penstock will be sufficient to develop 10,000 h. p.

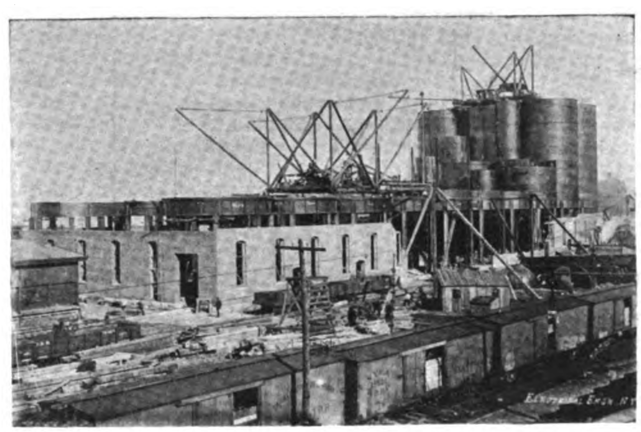
The power house building is now complete and the Power Company is pushing the interior as rapidly as possible. The turbines and dynamos will be of the same design as those in the present station.

GREAT NORTHERN GRAIN ELEVATORS IN BUFFALO.

BY ORRIN E. DUNLAP.

THE strength that President James Hill gives to the Great Northern Railway and Steamship Company is well portrayed in the magnificent new steel grain elevator that he is building in Buffalo. It shows that he is determined the companies he represents shall keep well abreast of the times. This elevator will be the greatest one of its kind in the country, and it will be operated by electric power from Niagara. This power has already been contracted for, and will be supplied through the Cataract Power and Conduit Company, distributing agents for Niagara power in Buffalo.

The elevator is to be known as the Great Northern, and its grain bins are to be huge steel cylinders. There will be three rows of these bins, ten in each row, or thirty in all. Each bin will have a capacity of about 100,000 bushels, making the total capacity of the elevator about 3,000,000 bushels. In order to support the immense weight of the bins when full, it was necessary that the foundation should be especially solid, and in order to secure solidity it was necessary to go down about 60 feet. On the foundation so laid a structure of steel



GREAT NORTHERN GRAIN ELEVATOR, BUFFALO, N. Y.

was erected, and on this steel work rest the bins. Each of the bins is about 84 feet high and 38 feet in diameter. Between the rows of large bins are smaller bins about 15 feet in diameter, and it is in these smaller bins that the grain is first put when taken from the vessels, after which it is placed in the large bins.

In the accompanying illustration the bins at the far end are shown at their full height, while the structural steel work beneath the bins is also well displayed. When the bins are completed the brick walls will be carried up around them, and this will give the elevator much the appearance of other buildings, hiding the modern construction of the bins. It is expected to have the elevator completed by next spring.

ON THE SOURCE OF ROENTGEN RAYS AND THE PRACTICAL CONSTRUCTION AND SAFE OPERATION OF LENARD TUBES.[1]

BY NIKOLA TESLA.

As will be remembered, in the first announcement of his discovery, Röntgen was of the opinion that the rays which affected the sensitive layer emanated from the fluorescent spot on the glass wall of the bulb; other scientific men next made the cathode responsible; still others the anode, while some thought that the rays were emitted solely from fluorescent powders or surfaces. My own experiments led me to recognize that, regardless of the location, the chief source of these rays was the place of the first impact of the projected stream of particles within the bulb. This was merely a broad statement, of which that of Prof. Röntgen was a special case, as in his first experiments the fluorescent spot on the glass wall was, incidentally, the place of the first impact of the cathodic stream. Investigations carried on up to the present day have only confirmed the correctness of the above opinion, and the place of the first collision of the stream of particles—be it an anode or independent impact body, the glass wall or an aluminum window—is still found to be the principal source of the rays. But, as will be seen presently, it is not the only source.

Since recording the above fact my efforts were directed to finding answers to the following questions: First, is it necessary that the impact body should be within the tube? Second, is it required that the obstacle in the path of the cathodic stream should be a solid or liquid? And, third, to what extent is the velocity of the stream necessary for the generation of and influence upon the character of the rays emitted?

In order to ascertain whether a body located outside of the

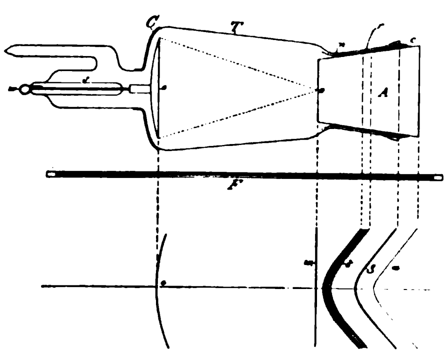


Fig. 1.

tube and in the path or in the direction of the stream of particles was capable of producing the same peculiar phenomena as an object located inside, it appeared necessary to first show that there is an actual penetration of the particles through the wall, or otherwise that the actions of the supposed streams, of whatever nature they might be, were sufficiently pronounced in the outer region close to the wall of the bulb as to produce some of the effects which are peculiar to a cathodic stream. It was not difficult to obtain with a properly prepared Lenard tube, having an exceedingly thin window, many and at first surprising evidences of this character. Some of these have already been pointed out, and it is thought sufficient to cite here one more which I have since observed. In the hollow aluminum cap, A, of a tube, as shown in diagram Fig. 1, which will be described in detail, I placed a half-dollar silver piece, supporting it at a small distance from and parallel to the window or bottom of the cap by strips of mica in such a manner that it was not touching the metal of the tube, an air space being left all around it. Upon exciting the bulb for about 30 to 45 seconds by the secondary discharge of a powerful coil of a novel type now well known, it was found that the silver piece was rendered so hot as to actually scorch the hand; yet the aluminum window, which offered a very insignificant obstacle to the cathodic stream, was only moderately warmed. Thus it was shown that the silver alloy, owing to its density and thickness, took up most of the energy of the impact, being acted upon by the particles almost identically as if it had been inside of the bulb, and, what is more, indications were obtained, by observing the shadows, that it behaved like a second source of the rays, inasmuch as the outlines of the shadows, instead of being sharp and clear as when the half-dollar piece was removed, were dimmed. It was immaterial for the chief object of the inquiry to decide by more exact methods whether the cathodic particles actually penetrated the window or whether a new and separate stream was projected from the outer side of the window. In my mind there exists not the least doubt that the former was the case, as in this respect I have been able to obtain numerous additional proofs.

I next endeavored to ascertain whether it was necessary that the obstacle outside was, as in this case, a solid body, or a liquid, or broadly, a body of measurable dimensions. I observed accidentally what is illustrated in Fig. 1. The diagram shows a Lenard tube of improved design, consisting of a tube, T, of thick glass tapering toward the open end, or neck, n, into which is fitted an aluminum cap, A, and a spherical cathode, e, supported on a glass stem, s, and platinum wire, w, sealed in the opposite end of the tube as usual. The aluminum cap, A, as will be observed, is not in actual contact with the ground glass wall, being held at a small distance from the latter by a narrow and continuous ring of tinfoil, r. The outer space between the glass and the cap, A, is filled with cement, c, in a manner described below. F is a Röntgen screen such as is ordinarily used in making the observations.

Now, in looking upon the screen in the direction from F to T, the dark lines indicated on the lower part of the diagram were seen on the illuminated background. The curved line, e, and the straight line, w, were, of course, at once recognized as the outlines of the cathode, e, and the bottom of the cap, A, respectively, although, in consequence of a confusing optical illusion, they appeared much closer together than they actually were. For instance, if the distance between e and o was 5 inches, these lines would appear on the screen about 2 inches apart, as nearly as I could judge by the eye. This illusion may be easily explained and is quite unimportant, except that it might be of some moment to physicians to keep this fact in mind when making examinations with the screen as, owing to the above effect, which is sometimes exaggerated to a degree hard to believe, a completely erroneous idea of the distance of the various parts of the object under examination might be gained, to the detriment of the surgical operation. But while the lines, e and w, were easily accounted for, the curved lines, t, g, a, were at first puzzling. Soon, however, it was ascertained that the faint line, a, was the shadow of the edge of the aluminum cap, the much darker line, g, that of the rim of the glass tube, T, and t the shadow of the tinfoil ring, r. These shadows on the screen, F, clearly showed that the agency which affected the fluorescent material was proceeding from the space outside of the bulb towards the aluminum cap, and chiefly from the region through which the primary disturbances or streams emitted from the tube through the window were passing, which observation could not be explained in a more plausible manner than by assuming that the air and dust particles outside, in the path of the projected streams, afforded an obstacle to their passage and gave rise to impacts and collisions spreading through the air in all directions, thus producing continuously new sources of the rays. It is this fact which, in his recent communication before mentioned, Röntgen has brought out. So, at least, I have interpreted his reported statement that the rays emanate from the irradiated air. It now remains to be shown whether the air, from which all foreign particles are carefully removed, is capable of behaving as an impact body and source of the rays, in order to decide whether the generation of the latter is dependent on the presence in the air of impact particles of measurable dimensions. I have reasons to think so.

With the knowledge of this fact we are now able to form a more general idea of the process of generation of the radiations which have been discovered by Lenard and Röntgen. It may be comprised in the statement that the streams of minute material particles projected from an electrode with great velocity in encountering obstacles wherever they may be, within the bulb, in the air or other medium or in the sensitive layers themselves, give rise to rays or radiations possessing many of the properties of those known as light. If this physical process of generation of these rays is undoubtedly demonstrated as true, it will have most important consequences, as it will induce physicists to again critically examine many phenomena which are at present attributed to transverse ether waves, which may lead to a radical modification of existing views and theories in regard to these phenomena, if not as to their essence, so, at least, as to the mode of their production.

[1]From The Electrical Review.

My effort to arrive at an answer to the third of the above questions led me to the establishment, by actual photographs, of the close relationship which exists between the Lenard and Röntgen rays. I prepared a tube in the manner described by Lenard in his first classical communication on this subject. The tube was exhausted to a moderate degree, either by chance or of necessity, and it was found that, when operated by an ordinary high-tension coil of a low rate of change in the current, no rays of any of the two kinds could be detected, even when the tube was so highly strained as to become very hot in a few moments. Now I expected that, if the suddenness of the impulses through the bulb were sufficiently increased, rays would be emitted. To test this I employed a coil of a type which I have repeatedly described, in which the primary is operated by the discharges of a condenser. With such an instrument any desired suddenness of the impulses may be secured, there being practically no limit in this respect, as the energy accumulated in the condenser is the most violently explosive agent we know, and any potential or electrical pressure is obtainable. Indeed, I found that in increasing the suddenness of the electromotive impulses through the tube—without, however, increasing, but rather diminishing the total energy conveyed to it—phosphorescence was observed and rays began to appear, first the feebler Lenard rays and later, by pushing the suddenness far enough, Röntgen rays of great intensity, which enabled me to obtain photographs showing the finest texture of the bones. Still, the same tube, when again operated with the ordinary coil of a low rate of change in the primary current, emitted practically no rays, even when, as before stated, much more energy, as judged from the heating, was passed through it. This experience, together with the fact that I have succeeded in producing by the use of immense electrical pressures, obtainable with certain apparatus designed for this express purpose, some impressions in free air, have led me to the conclusion that in lightning discharges Lenard and Röntgen rays must be generated at ordinary atmospheric pressure.

I have already described the form of tube illustrated in Fig. 1, and in Fig. 2 another still further improved design is shown. In this case the aluminum cap, A, instead of having a straight bottom as before, is shaped spherically, the center of the sphere coinciding with that of the electrode, e, which itself, as in Fig. 1, has its focus in the center of the window of cap, A, as indicated by the dotted lines. The aluminum cap, A, has a tinfoil ring, r, as that in Fig. 1, or else the metal of the cap is spun out on that place so as to afford a bearing of small surface between the metal and the glass. This is an important practical detail as, by making the bearing surface small, the pressure per unit of area is increased and a more perfect joint made. The ring, r, should be first spun out and then ground to fit the neck of the bulb. If a tinfoil ring is used instead, it may be cut out of one of the ordinary tinfoil caps obtainable in the market, care being taken that the ring is very smooth.

In Fig. 3 I have shown a modified design of tube. This, as will be observed, is a double focus tube, with impact plates or iridium alloy and an aluminum cap, A, opposite the same. It will be noted that the aluminum caps in the tubes described are fitted inside of the necks and not outside, as is frequently done. Long experience has demonstrated that it is practically impossible to maintain a high vacuum in a tube with an outside cap. The only way I have been able to do this in a fair measure is by cooling the cap by a jet of air, for instance, and observing the following precautions: The air jet is first turned on slightly and upon this the tube is excited. The current through the latter, and also the air pressure, are then gradually increased and brought to the normal working con-

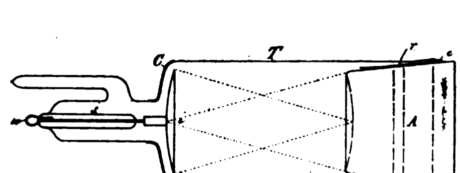


FIG. 2.

dition. Upon completing the experiment the air pressure and current through the tube are both gradually reduced and both so manipulated that no great differences in temperature result between the glass and aluminum cap. If these precautions are not observed the vacuum will be immediately impaired in consequence of the uneven expansion of the glass and metal.

With tubes, as those described, it is quite unnecessary to observe this precaution if proper care is taken in their preparation. In inserting the cap the latter is cooled down as low as it is deemed advisable without endangering the glass, and it is then gently pushed in the neck of the tube, taking care that it sets straight.

The two most important operations in the manufacture of such a tube are, however, the thinning down of the aluminum window and the sealing in of the cap. The metal of the latter

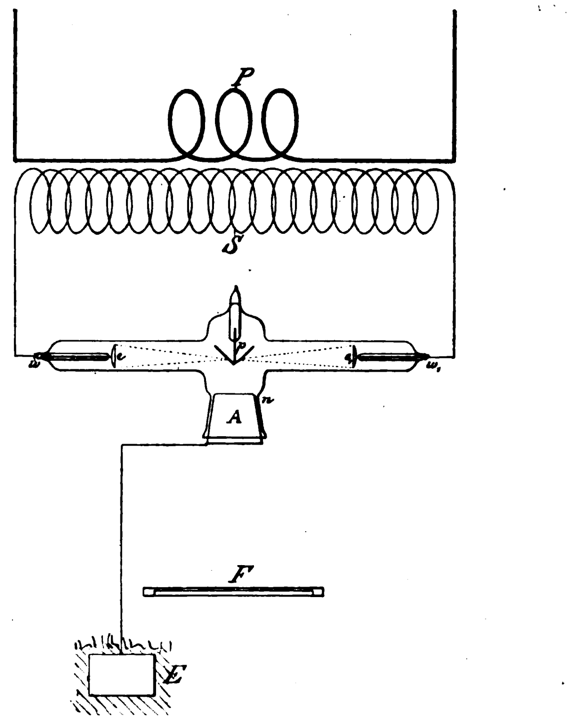


FIG. 3.

may be 1-32d or even 1-16th of an inch thick, and in such case the central portion may be thinned down by a countersink tool about ¼th of an inch in diameter as far as it is possible without tearing the sheet. The further thinning down may then be done by hand with a scraping tool; and, finally, the metal should be gently beaten down so as to surely close the pores which might permit a slow leak. Instead of proceeding in this way I have employed a cap with a hole in the center, which I have closed with a sheet of pure aluminum a few thousandths of an inch thick, riveted to the cap by means of a washer of thick metal, but the results were not quite as satisfactory.

In sealing the cap I have adopted the following procedure: The tube is fastened on the pump in the proper position and exhausted until a permanent condition is reached. The degree of exhaustion is a measure of perfection of the joint. The leak is usually considerable, but this is not so serious a defect as might be thought. Heat is now gradually applied to the tube by means of a gas stove until a temperature up to about the boiling point of sealing wax is reached. The space between the cap and the glass is then filled with sealing wax of good quality; and, when the latter begins to boil, the temperature is reduced to allow its settling in the cavity. The heat is then again increased, and this process of heating and cooling is repeated several times until the entire cavity, upon reduction of the temperature, is found to be filled uniformly with the wax, all bubbles having disappeared. A little more wax is then put on the top and the exhaustion carried on for an hour or so, according to the capacity of the pump, by application of moderate heat much below the melting point of the wax.

A tube prepared in this manner will maintain the vacuum very well, and will last indefinitely. If not used for a few months, it may gradually lose the high vacuum, but it can be quickly worked up. However, if after long use it becomes necessary to clean the tube, this is easily done by gently warming it and taking off the cap. The cleaning may be done first with acid, then with highly diluted alkali, next with distilled water, and finally with pure rectified alcohol.

These tubes, when properly prepared, give impressions much sharper and reveal much more detail than those of ordinary make. It is important for the clearness of the impressions that the electrode should be properly shaped, and that the focus should be exactly in the center of the cap or slightly inside. In fitting in the cap, the distance from the electrode should be measured as exactly as possible. It should also be remarked that the thinner the window, the sharper are the impressions, but it is not advisable to make it too thin, as it

is apt to melt in a point on turning on the current.

The above advantages are not the only ones which these tubes offer. They are also better adapted for purposes of examination by surgeons, particularly if used in the peculiar manner illustrated in diagrams, Fig. 3 and Fig. 4, which are self-explanatory. It will be seen that in each of these the cap is connected to the ground. This decidedly diminishes the injurious action and enables also to take impressions with very short exposures of a few seconds only at close range, inasmuch as, during the operation of the bulb, one can easily touch the cap without any inconvenience, owing to the ground connection. The arrangement shown in Fig. 4 is particularly advantageous with a form of single terminal, which coil is diagramatically illustrated, P being the primary and S the secondary. In this instance the high-potential terminal is connected to the electrode, while the cap is grounded. The tube may be placed in the position indicated in the drawing, under the operating table and quite close, or even in contact with the body of the patient, if the impression requires only a few seconds as, for instance, in examining parts of the members. I have taken many impressions with such tubes and have observed no injurious action, but I would advise not to expose for longer than two or three minutes at very short distances. In this respect the experimenter should bear in mind what I have stated in previous communications. At all events it is certain that, in proceeding in the manner described, additional safety is obtained and the process of taking impressions much quickened. To cool the cap, a jet of air may be used, as before stated, or else a small quantity of water may be poured in the cap each time when an impression is taken. The water only slightly impairs the action of the tube, while it maintains the window at a safe temperature. I may add that the tubes are improved by providing back of the electrode a metallic coating, C, shown in Fig. 3 and Fig. 4.

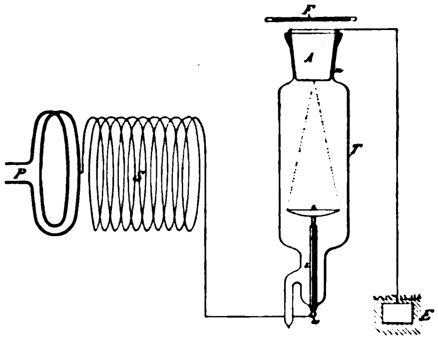


FIG. 4.

NEWS AND NOTES

ELECTRICITY AT THE BRUSSELS EXHIBITION.

(From our own Correspondent.)

THE Brussels Exhibition as a whole is quite interesting and very creditable to Belgium. Of course, it does not make any pretense of comparison with either Chicago, 1893, or Paris, 1889. No attempt has been made at lavish expenditure on building façades. The existing buildings of some royal museums, of one sort or another, have, indeed, been utilized as the façade, and it was only necessary to put up a series of sheds at the rear to make a decent and relatively inexpensive outfit of buildings. The park in which the buildings are situated forms a most artistic and beautiful foreground for the whole.

A portion of the grounds have had, of course, to be given up to various "side-shows," cafés, restaurants, etc. One of the really very interesting and beautiful side-shows is the "Panorama des Alpes." There is also a "Kermesse," which reminds one of "Old Vienna" of the Chicago Midway. It is enclosed by walls, like a fortified village, and contains an even larger number of odd Flemish and Belgian structures of all sorts and for all purposes, than did the "Old Vienna" of Austrian buildings.

Of course, the ubiquitous, loud-mouthed, vulgar oriental—he of the Midway Plaisance, is here, with his camels, donkeys, sword-dances, and "other" dances. He is not so numerous, but still is as much, yea, even more, in evidence, for he constitutes a larger percentage of the exotic element than he did at Chicago. He speaks even worse French than he did English at Chicago. He peppers and salts it freely with Flemish, which is bad enough when done by the Belgians, most of whom at least do know, occasionally, a little French. One can analyze the whole electrical part of the show in five minutes with ease and with time to spare.

The Société Gramme is, I think, the only foreign exhibitor of dynamos, except the Société Breguet, which exhibits a "Laval" steam turbine dynamo outfit rated at 150 h. p.; for it is noteworthy that almost everybody here rates dynamos by horse-power, and not by kilowatts of output, as in America. The other dynamos are exhibited by Belgian makers. The dynamos are all of the belted type, most of them small, the largest being about 75 k. w. They present no new features and recall for the most part our American "efforts" at designing belted dynamos, as evidenced at the World's Fair of 1893. Such a thing as expecting a dynamo to run sparkless from no load to full load, without change of brush lead, is still here one of the things left to the future, as it was with us in 1893, although it is now one of the usual requirements in our first class work.

There is an attempt to show long distance transmission—from Tervueren to Brussels—but even this exhibit is also a miniature. The power is transmitted a few kilometres at 4,000 volts, and furnishes a little power, such as for pumping water for the illuminated fountain.

The said fountain is rather a dismal exhibit, considering the fact that it "chews up" nearly 600 amperes, for supplying 48 arc lamps. They simply turn on the water and the current, and "let her go." Once in a while they shift the color screens. No attempt is made at varying the number, form and combination of water jets, or at giving different colors to different parts of the jets, as was so beautifully done at Chicago. Altogether the fountain is rather elementary, and about ten years behind the times.

One of the most interesting American exhibits is in the British section! It is an exhibition of electric traction materials, by Robert W. Blackwell, whom many of your readers will doubtless well remember, as the quondam manager of the Bentley-Knight Company. Mr. Blackwell is the American agent for a good deal of our best American electric traction material (line material, track material, car trucks, motors, trolley poles, etc.). He has an extensive suite of offices (comprising about the whole of one floor) in one of the finest office buildings in London, and is ably seconded by his chief assistant, Mr. Phillip Dawson, whose name is also well known in America. Both Mr. Blackwell and Mr. Dawson are members of the jury at Brussels. Their names are also identified with many electric railway lines in Great Britain and all over Europe, for which they have furnished materials, equipment, and, in many cases, have had full charge of every detail of the engineering and equipment. Their exhibit at Brussels is very complete and very interesting. It includes many ingenious trolleys, and some ornamental trolley line poles and brackets of their own design, which do them honor and might profitably be copied in America.

The grounds are illuminated by incandescent lamps entirely. The lamps are arranged in festoons, and also set in the trees, and each is covered by a globe, made of celluloid or other translucent material, colored green, red, yellow and blue. The effect is very pretty and gives the garden a fairy-like aspect, both at night and during the day.

PROF. DOLBEAR SHAKES HANDS WITH PROF. FARMER'S GHOST.

THE following story, told in a dispatch from Boston, will recall to mind the late Prof. Farmer's tendencies toward spiritualism: Prof. Dolbear has just returned from Eliot, Me., where the convention of the American Institute of Electrical Engineers was held in honor of Moses G. Farmer, one of the pioneer inventors in the field of electricity. Just half a century before to a day Mr. Farmer had operated successfully an electric car at Dover, N. H. During many years of his life Mr. Farmer lived at "Bitter Sweet," a homestead place, where he died a few years ago, and where his daughter, Miss Sarah J. Farmer, still lives. Miss Farmer entertained Prof. Dolbear, and on last Sunday the professor slept in a room somewhat noted locally as the "room of the seven doors." It is on the second floor, a small, nearly square room, that is light, airy and comfortable. Its most notable feature is its collection of

doors. The seven are all just alike, and apparently of the same size. They were finished in the natural wood, and each had a white China door knob.

"Let me tell you something about that room," said Prof. Dolbear, "or, rather, about something that happened to me there. I had been talking of Farmer with his daughter that evening, and when I turned in I was thinking of him. How long I lay there before sleeping, or whether I went to sleep at all, I do not know, but presently I was conscious of some presence in the room. A moment later I saw Farmer standing by the bed. At least I recognized the figure as that of Farmer, and I was surprised, but I do not recall that I was very much startled. 'Hello,' he said, or something of that sort—a salutation, at all events. I replied in kind, and said, 'Who are you?' 'I am Farmer,' was the answer, and he held out his hand to me.

"I shook hands with him, and I thought as I did so that the fingers felt a little cold. I released the hand and was thinking about the matter while considering what next to say. When I looked up he was gone. If I was awake at the time I fell asleep again; at any rate, I let the matter pass, though somewhat puzzled, but very soon I found the figure was again standing by the bed. I do not know that I doubted it was Farmer, but I thought I would make certain, so I said:

"'How shall I know you are Farmer?'

"'I will show you my hand,' he said. In the dark I saw he was holding out his hand that I might see it, but I was determined to take nothing for granted, so I said:

"'But how shall I know it is Farmer's hand?'

"'I'll show you my finger,' he replied, and then he crooked up one of the fingers in such a peculiar way that I tried to imitate him. I could not do it without the assistance of the other hand, and while I was trying to perform the little trick the figure disappeared. I puzzled over the vision, or dream, or what you choose, for some time, but then I once more went to sleep—if I had been awake—and I saw nothing more of the figure. In the morning I told Miss Farmer of my experience, to her very great interest. When I came to the trick of the fingers she looked at me astonished.

"'That,' she said, when illustrated as best I could, 'was a favorite little trick of my father; few people could do it.'

"It appears," Prof. Dolbear concluded, "that whenever Farmer met a person to whom he took a liking, when the acquaintance came to an informal footing, it was his way to hold out his hand, crooking his finger in the way I have shown you, to say, 'can you do that?' It was a little thing, perhaps, but peculiar to the man. We all have minor characteristics by which we may be known."

PAN-AMERICAN ELECTRICAL EXPOSITION AT NIAGARA.

IT is proposed to hold a Pan-American Electrical Exposition on Cayuga Island, Niagara Falls, in 1899. Cayuga Island is not exactly within the limits of the city of Niagara Falls, but it is not far distant, and by mentioning it in connection with the Falls its location is well defined, for who does not know of Niagara Falls? The project has been before the public through various announcements for some little time, but now the promoters of it state that their plans are maturing so that their permanent organization will be soon formed. Capt. J. M. Brinker, president of the Niagara Falls & Lewiston electric road, is at the head of the scheme, and he has interested several prominent men, among them General Superintendent Edgar Van Etten, of the New York Central, who can do much to make the project a success.

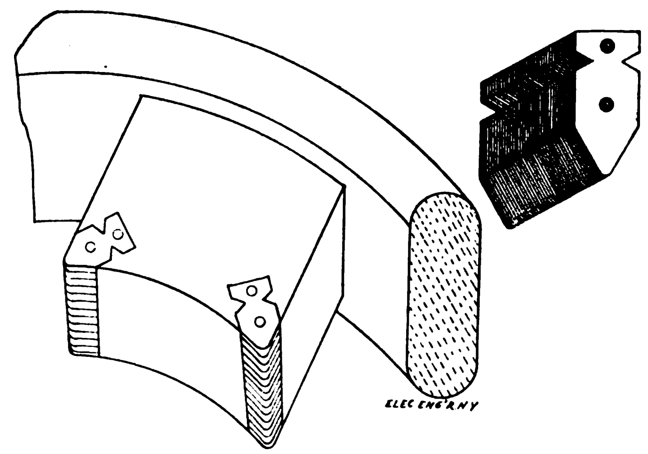
It is the idea of the promoters that the exposition shall represent and display the progress made during the last century, and especially is it designed to portray the progress made in the electrical field. So far as possible, the power and light used on the grounds will be furnished by electricity generated in the great power houses at the Falls, and in every way will the progress of the century then closing be compared with the past. It is the idea of the men who are back of the scheme that as the Falls of Niagara draw about 500,000 people to see them annually, the additional attraction of the Pan-American Exposition will swell the crowds of visitors to proportions far beyond those ever seen at any exposition in the world.

The desirability of Cayuga Island as a location for such a great exposition as is proposed will be well understood when it is stated that to-day the trains of the New York Central, the West Shore, the Michigan Central, the Lake Shore & Michigan Southern, the Lehigh Valley, the Canadian Pacific, the Wabash, the Erie, the Rome, Watertown & Ogdensburg and the Grand Trunk railroads pass within 200 feet of the island on their regular runs. Thus, the railroads of the country lead to Cayuga Island. In addition to this the cars of the Buffalo-Niagara Falls trolley line pass still closer, while, as the island is located in Niagara River a safe distance above the Falls, steamboats from the Great Lakes can land their passengers right on the exposition grounds.

RUSHMORE LAMINATED POLE CORNERS.

IN large machines with toothed armatures provision must be made to avoid heating due to eddy currents set up in the pole-pieces and with solid poles this heating is so great that it is necessary to have a large clearance which reduces the capacity of the machines and wastes copper and energy in the field coils. Most makers to-day overcome this difficulty by making the entire poles of laminated iron bunched together and cast solid into the field ring and while this method is very effective it is very costly.

It is well known that the heating of the poles is chiefly, if not entirely, at the corners or edges. In a dynamo it is in the



FIGS. 1 AND 2.—RUSHMORE LAMINATED POLE EDGES.

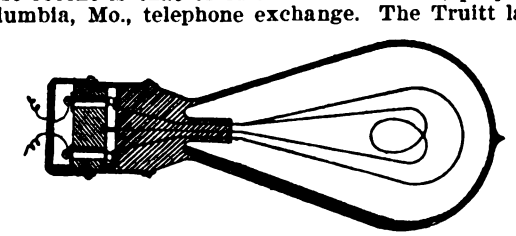
edges from which the teeth are being drawn, and in a motor the edges to which the teeth approach, and it therefore occured to Mr. S. W. Rushmore, of Jersey City, N. J., that it was necessary to laminate only the corners where the heating takes place.

Fig. 1 shows the new method with laminated sections cast into the corners of the poles. Fig. 2 shows a bunch of the iron punchings used. It will be seen that there is a great saving in labor and material over laminating the entire poles, while very few tools are required as one size punching may be used for a number of sizes of machines.

This method, which has recently been patented, is used in all the large machines built by the Rushmore Dynamo Works, of Jersey City, N. J., and it has been found fully as effective as with entire poles laminated, and the clearance may be made as small as desired.

THE TRUITT REGULATING LAMP.

NUMEROUS devices have been brought out for effecting the turning down of the light of incandescent lamps and the most recent is that of Mr. Clarence Truitt, proprietor of the Columbia, Mo., telephone exchange. The Truitt lamp, as



THE TRUITT REGULATING LAMP.

shown in the accompanying engraving, is a multiple filament lamp, with the base so arranged that any one of the filaments can be put in circuit by turning the lamp in its socket. The lamp can be run at from 2 to 24 c. p.

PATERSON, N. J.—The Edison station at Paterson was temporarily disabled at the beginning of this week by the collapse of its large coal storage bin, the loose contents of which prevented the operation of the plant.

PERSONAL

CAMPBELL SCOTT.

THIS gentleman, who has recently taken charge of the C & C Electric Company's sales in Greater New York, and of their advertising, is well known already in electrical circles. His first engagement in the field was with the old Gaynor Electric Company, of Louisville, Ky., who made the Gaynor fire alarm system, and were the Southern agents for the Sprague motors. He then took charge in the Sprague railway department and was successful in equipping several large electric systems in Southern cities. In 1890, when the Sprague Company was absorbed by the Edison General Electric Company, he became manager for the latter of their Louisville office, and then of that at Cincinnati. In 1892, prior to the foundation of the General Electric Company, he resigned and organized the Southern Engineering Company, of Louisville, which under his presidency did a very large business. In 1894, he organized the Louisville Electrical Works, and went extensively into the manufacture of transformers. He sold out of this business in 1896 to join the C & C Company as its Southern manager at Atlanta, and during the past year and a half has established it firmly and favorably through a large part of the Southern States. He has now moved on to New York at a happy juncture in the company's affairs and is applying all his energy and ripe experience to the promotion of its interests in the great fields of power current generation, transmission and application.

LORD KELVIN, accompanied by Lady Kelvin, arrived last Friday by the "Campania," and proceeded to Toronto by way of Niagara, where he took occasion to inspect closely the plant. Lord Kelvin has not visited this country for several years.

MR. GEORGE HELI GUY has an excellent article on electricity in medicine and in sanitariums, etc., appearing in the August "Chautauquan." It is admirably written and full of interesting data.

MR. O. H. FERNBACH, a graduate of Cornell, has been selected by the Japanese authorities to supervise the construction of a trolley road near Tokio.

MR. HENRY G. ISSERTEL, E. E., consulting engineer, has withdrawn from the firm of Crafts & Issertel, but will continue as sales agent for the Walker Company, with office at the northwest corner of Wall and Nassau streets, New York.

MR. JUSTUS ECK, M. A., read a very interesting paper before the International Tramways Institute of Great Britain, on the Walker system of electric traction, last April. It has now been printed in brochure form by the Walker Manufacturing Company, of Cleveland, and forms a welcome addition to railway literature.

MR. E. TREMLETT CARTER, of the editorial staff of the London "Electrician," has arrived in New York, and will attend the British Association meeting at Toronto.

SOCIETY & CLUB NOTES

A CHICAGO "BATTERY PARTY."

THE people of Chicago are now enjoying what are known as "battery parties." The Englewood & Chicago, the new storage battery road, at the present time has about twenty motor cars in successful operation over its twenty-four miles of track. The road runs through some of Chicago's most beautiful suburban districts and is becoming very popular for picnic parties and excursions. The cars run in regular service about eighteen miles an hour, and the smoothness of the roadbed removing all the jolt and jar makes a ride over the line a most pleasant experience.

On Saturday, August 17, a large portion of Chicago's electrical fraternity accepted the invitation of the Central Y. M. C. A. Electrical Club to an excursion of inspection over the road. Special battery cars were kindly furnished by Superintendent Davies, and carried the party to Blue Island and Morgan Park, stopping some time at the power house.

Much interest was shown in the ingenious appliances devised by Gen. Manager Condict for changing the batteries on the car. This arrangement, with the aid of but one operator, and in less than a minute and a half, removes the four-ton tray of discharged cells and replaces them with a charged set ready for another twenty-four-mile trip.

The model power house, with its economical appliances of condensers, cooling tower and economizer, was carefully inspected, while the steady load indicated by the ammeter dials on the switchboard created considerable comment. The system of connecting the engines and generators, which was devised by B. J. Arnold, the consulting engineer of the company, and which allows a 1,000 h. p. plant of four units to be installed in an engine room 70 feet long by 30 feet wide, and makes possible the operation of four direct connected generators from one engine, was much appreciated by the engineers of the party.

The discovery of the day, however, was made when the cars were backing out from the siding at the power house to continue the trip, when the ladies of the party, who were in charge of Mr. Sullivan, of The Electrical Engineer, were much interested in finding that "the batteries worked both ways."

The afternoon was an instructive as well as an enjoyable one and the Y. M. C. A. club added considerably to the reputation which it is making for unique entertainments.

AM. ASSOC. AD. SCI. AT DETROIT.

In accordance with the programme, the American Association for the Advancement of Science held its annual meeting at Detroit last week. There were a great many good papers, in all the departments, and some of them are noted in this issue. But the attendance as usual was very small, less than 300 having registered. For some reason or other the association does not gather the number of members that its work would appear to warrant.

This week the British Association holds its meeting at Toronto, in the University Building, and several will go thither from Detroit. The attendance from England alone is shown by the lists to be over 200, many of whom came over on the steamer "Parisian" to Montreal. Others, like Lord Kelvin, have arrived by way of New York.

OBITUARY

S. M. CANTY.

The death is announced of Stephen M. Canty, of the Southern New England Telephone Company, aged 36. He was found dead in his chair one morning last week, and his disease is said to have been heart trouble, due to cigarette smoking. He was in the company's equipment force.

TELEPHONY AND TELEGRAPHY

ENGLISH TELEGRAPHERS NOT TO STRIKE.

A special dispatch from London of August 13 says: The telegraphers connected with the Postoffice Department of the government held a great meeting this evening to discuss the question of a strike, in view of the decision of the Duke of Norfolk, the Postmaster General, with respect to the principal grievances recently laid before him by a committee of the Telegraph Clerks' Association. The Postmaster General in his reply to the petition declined to agree to an increase of the maximum salary from £160 to £190, though he promised to relieve the pressure of work by appointing forty additional superintendents and to abolish technical examinations in the case of candidates for senior grades of clerks. To-night's proceedings showed that the expected and requisite support from the Postal Telegraph clerks in the provinces is not forthcoming, and the meeting decided not to strike, but to continue to press the claims of the London association upon the government with greater resolution.

LEGAL NOTES

BROOKLYN TROLLEY DAMAGE SUITS.

Hereafter the Brooklyn Heights trolley railroad will not fight small damage claims in the court, but will settle them privately whenever possible. Fifty-four of these actions brought by parents or guardians of children who have been injured by the cars of the company have just been closed by the payment of judgments amounting to $4,132. The suits covered a period of nearly a year.

TROLLEY INJUNCTION SUSPENDED.

An order has been entered by Judges Dallas, Butler and Kirkpatrick suspending the preliminary injunction granted in the Circuit Court at Pittsburg in the suit of the Thomson-Houston Electric Company against the Johnson Company and others for alleged infringement on improvements in suspended switch and traveling contact for electric railways, under the sixth, seventh, eighth, twelfth and sixteenth claims of patent No. 495,443.

The Johnson Company, of Pennsylvania, R. T. Lane, A. J. Moxham, Claude M. Johnson, John R. Hoefgan, Daniel Coolidge, William A. Donaldson, A. V. Dupont, the Steel Motor Company, Johnson Company, of Kentucky, and the Johnson Company, of Ohio, are the appellants and the Thomson-Houston Electric Company is the appellee.

TROLLEY DECISION IN FAVOR OF THE JEFFREY MANUFACTURING COMPANY.

At Columbus, Ohio, in the case of the Thomson-Houston Electric Company against the Jeffrey Manufacturing Company, a suit on account of alleged infringement of the Van Depoele patents, Clerk White, of the United States Court, has issued the opinion of Judge Clark. In the decision he first allows a preliminary injunction upon complaint, giving bond in $15,000. After the signature attached to this the judge says that since writing the opinion he has been furnished an opinion from the Circuit Court of Appeals of the Second District, in which similar claims have been held to be invalid, these claims having been upheld by Judge Townsend, whose opinion he was following. He says: "I am now constrained to think that I would not be warranted by the rule referred to in accepting Judge Townsend's conclusion as a basis for preliminary injunction, since his opinion has been disapproved by a court of review. . . . I am of the opinion that I should not as this stage of the case allow a preliminary injunction. I think I should not do so before the October term of the court," and gives his reasons for the statement.

THE STOCK MARKET

GOOD OUTLOOK ALL AROUND.

THERE is no longer any question about the general improvement in business or the strength of the stock market. Bank clearings, railroad receipts, trade reports, high prices of agricultural products, busy times in many factories, all tell the same story, and the conditions bid fair to accentuate themselves sharply as the days go by and the fall season comes on.

On the New York stock market last week 3,480,000 shares were sold, and the sales of bonds reached $21,500,000, the largest amount in six days since 1893, comparing with only $6,500,000 in the same week last year. During the week Western Union gained 1⅜ up to 93¾ on sales of 102,489 shares. General Electric stood firm around 37 and 38 on sales of 22,880, but is inclined to be unsettled on talk of a deal as to the long unpaid dividends of two or three years' accumulation on the preferred stock. American Bell has risen to 237 on sales below 1,000 shares as usual. New York Edison has advanced 1½ to 125¼.

COPPER is firm with a rising tendency, if any, on large sales. Lake Superior is at 11 cents for September delivery; 10¾ for electrolytic, and 10⅝ for casting stock.

STEEL RAILS are quoted at $20 per ton.

REPORTS OF COMPANIES

ANGLO-AMERICAN TELEGRAPH CO.

The report of the Anglo-American Telegraph Company for the year ended June 30, states that the total receipts from January to June 30, including the balance of £369 brought forward from the last account, amounted to £166,558. The traffic receipts show an increase of £5,935, compared with same time last year. The total expenses of the half year, including the repair of cables, etc., as shown by the revenue account, amounted to £53,301, being a decrease of £3,727. The directors, under the powers conferred upon them by the articles of association, have before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £101,257. One quarterly interim dividend of 12s. 6d. per cent. on the ordinary stock and of £1 5s. per cent. on the preferred stock was paid on May 1, 1897, absorbing £43,750, and a second quarterly dividend of 14s. per cent. on the ordinary stock and £1 8s. per cent. on the preferred stock, amounting to £49,000, was paid on July 31, 1897, leaving a balance of £8,507 to be carried forward to the next account.

BROWNELL CAR CO.

The Brownell Car Company, St. Louis, has filed a deed of trust for the benefit of creditors, numbering over 100. The total amount of indebtedness is said to exceed $200,000, the deed of trust covering everything owned by the car company, including 150 feet of ground on Monroe street and fourteen other pieces of property.

TO EXPORT AMERICAN ALUMINUM.

It was announced last week that contracts had been signed for the shipment of 1,000 tons of aluminum to the English market. The order was placed in open competition with all the aluminum works of Enrope. The total American output of aluminum for 1896 was about 1,300,000 pounds, and it is estimated that the production for 1897 will reach 2,000 tons, of which, it is expected, 1,000 tons will be consumed in the United States. The delivery of the English order will cover a period of four years.

EDUCATIONAL

LEHIGH UNIVERSITY.

Lehigh University has made a well advised extension of its curriculum. The authorities of the university, being convinced that many men who desire eventually to study a technical profession would appreciate a preliminary literary education, have decided to offer such persons an opportunity of combining culture studies with those which belong to practical life. Any student in the literary courses who wishes to do so will be permitted to substitute such technical studies as are approved by the faculty, for a portion of the regular work of the junior and senior years. At the end of the four years he will receive the literary degree appropriate to his course. If he then chooses to complete the technical course to which the substituted studies belong he can do so, and may receive the technical degree in a period determined by his diligence.

AGRICULTURAL COLLEGE, MICH.

The mechanical department of the Agricultural College Mich., has arranged an elaborate series of reference cards in connection with its course of instruction. It oftens happens that young men who wish to enter a college or university have not had the preliminary training which is insisted on as a requisite for admission. It is to meet such cases as these that the Agricultural College especially offers its facilities for the study of mechanical engineering. The admission requirements, as well as the fees, are modest.

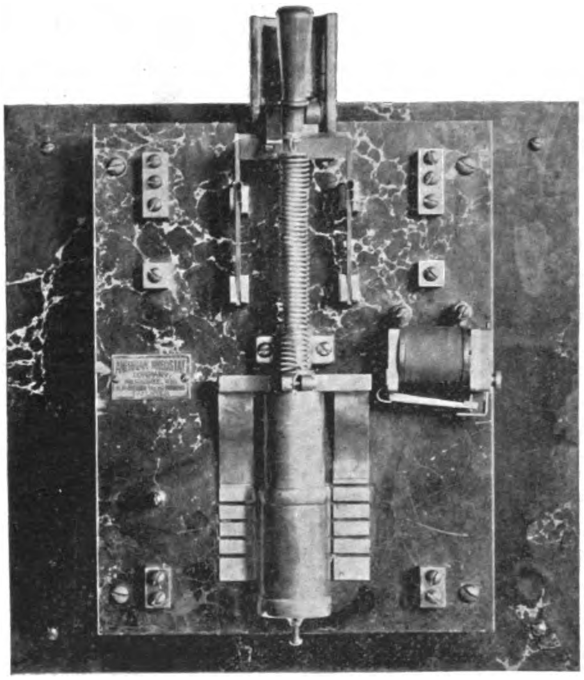
TRADE NOTES & NOVELTIES

THE PERFECTION RHEOSTAT.

IT may be considered a bold thing to call a piece of apparatus "Perfection," but the American Rheostat Company, of Milwaukee, Wis., appear to be justified in so designating their latest type of motor-starting rheostat.

This rheostat consists of a double pole knife switch, fuse block, release magnet, overload magnet and automatic circuit breaker all on one slate front. The operator closes the switch, pressing the handle somewhat, which brings a plate connected with the switch in contact with the stem of the plunger, and thereby removes the pressure from the latch. This being done, the magnet immediately draws the latch and on letting go of the handle of the switch it is retained by the latch, if there is current passing the fields; otherwise it will not catch the latch.

If the switch is retained resistance is automatically cut out of circuit. If an overload occurs the overload magnet acts, and re-



"PERFECTION" RHEOSTAT.

leases the latch, thereby opening the double pole knife switch. If from any cause the resistance is cut out of circuit when the knife switch is open, it is impossible to close the knife switch. If, on closing the switch, the current is excessive, thereby causing the overload to act, it will simply prevent the cutting out of resistance until the overload drops, when the latch will retain the knife switch, and the resistance will be automatically cut out of circuit.

With this rheostat the knife switch, fuse block, circuit breaker and accompanying switchboard and connections are all done away with.

The rheostats are built in capacities of from ⅓ to 100 h. p. and for 125, 240 and 500-volt circuits.

THE STANDARD UNDERGROUND CO. AND PAPER CABLES.

The following notice and guarantee is being issued by the Standard Underground Cable Company: "Our attention has been called to the somewhat extravagant pretensions put out by interested parties, wherein claim is made, in substance or effect, of an exclusive patented monopoly of paper insulated electric cables and wires. We have been manufacturing and selling wires and cables of that kind for many years, and under advice of counsel, we have no doubt whatever as to our right to do so. We, therefore, advise you that as regards any such wires and cables which you may purchase from us, we will be prepared at any and all times, at our own charge and expense, to defend any suit or suits brought against you for infringement of the patent referred to, we to be promptly notified of such suit or suits, and to be allowed an opportunity to make defense therein."

ACTIVITY OF THE C & C ELECTRIC CO.

It is most gratifying to hear such conservative concerns as the C & C Electric Company express their belief that the long and eagerly looked-for "good times" have at last come back in earnest, and this time to stay. One of their representatives stated a few days ago that they have received more orders, and substantial ones at that, for electrical machinery of various types and for numerous uses, during the last six weeks than they had during the previous three months. As a consequence their whole office force is "head over ears" at work, while preparations are being made to run their large shops at Garwood, N. J., both day and night with a largely increased force until they are able to catch up. Large orders have come to them during this month, not only from all over the United States, but from Central America, Japan, South America and South Africa, the latter being an evidence that the fame of C & C apparatus is worldwide.

NEW ENGLAND NOTES

FITCHBURG STEAM ENGINE COMPANY, of Fitchburg, Mass., are busy on orders. Their engines are installed in many plants throughout the country, among which can be mentioned the Mt. Morris Electric Light Company, Consolidated Gas Company, of New Jersey, at Long Branch, N. J., and notably the new shops of the Boston & Maine Railroad, at Concord, N. H., where the power is chiefly distributed by the electric motor. J. D. Miller & Co., 39 Cortlandt street, New York, are the New York selling agents.

THE ANSONIA ELECTRICAL COMPANY, Ansonia, Conn., have plenty of work on hand. They manufacture a large number of electric house goods supplies, and Shield Brand moisture-proof feeder and line wires, also annunciator magnet, damp-proof office wire, etc.

MR. G. H. ALMON, of Montpelier, Vt., has been awarded the contract for wiring the Vermont State House in that city, for $2,250. The building is to be wired throughout for 500 lamps of 24 c. p., and all wires are to be run in iron conduit.

MOSSBERG & GRANVILLE MANUFACTURING COMPANY, Providence, R. I., have just issued a very handsome new and profusely illustrated catalogue of over 200 pages. It will be promptly mailed on request to intending purchasers of power presses, drop presses, rolling mill machinery, wire drawing machinery, roller bearing gauges, roller bearer hangers for shafting, etc. These hangers are guaranteed specifically to save 50 per cent. of the power. The concern make a feature of designing and manufacturing machinery for special purposes, and will be glad to estimate on same, particularly if it is of the automatic type and intricate.

PROVIDENCE, R. I.—The American Electrical Works clambake takes place on Saturday at the Powham Club.

SOUTHERN NOTES

NEWPORT NEWS, VA.—The Newport News Shipbuilding and Dry Dock Company are making extensive additions to their already large plant. One under way is the erection of an extension to their machine shop, which will be 100 feet wide and 200 feet long. This building will be used for the finishing and erecting of marine engines and other large machinery used in connection with the mammoth steel vessels which this company have under way. The central portion of the building will be 50 feet high, and will be supplied with an electric traveling crane capable of lifting and carrying a load of 50 tons. On either side of this central space will be located a gallery arranged for small machines and fitting tools. The building is to have a steel framework throughout, and the roof is to be covered with corrugated iron. The Berlin Iron Bridge Company, of East Berlin, Conn., have the contract for furnishing and erecting the steel work of the building.

WESTERN NOTES

MICHIGAN AVENUE, CHICAGO, is now to be lighted electrically its entire length up to Thirty-ninth street, thirty-six arcs taking the place of 300 gas lamps. The circuits will be run with Standard underground cable in McRoy terra cotta conduits.

THE HIGHLAND ELECTRIC SOLDERING PASTE is meeting with a very large sale, and the Electric Appliance Company, who are pushing this specialty in the West, state that it promises fair to displace the well known soldering sticks and soldering acids, as it has many advantages over both of these two methods of making a joint. The Electric Appliance Company are still sending free samples on application.

DAVIS GLASS CO., Pittsburg, Pa., is, it is said, going to put on the market a new form of underground conduit, composed of glass, iron and asbestos. The inventor is Mr. John Locke, and Mr. Joseph Davis is the president of the new company.

WARREN, O.—A special pleasure trip was made last month to Conneaut Lake from Warren, when the entire force of the Warren Electric and Specialty Company went as guests of the concern, to the number of 150. The train was decorated and the party were under the care of Mr. E. W. Gillmer, the general manager. The excursion was greatly enjoyed.

EATON, O.—The Eaton Telephone Association is to distribute weather reports to seven stations and to about fifty farmers who have instruments.

HUGHES POLICE AND FIRE SIGNAL SYSTEM, 511 Sansome street, San Francisco, is being put on the market by Messrs. E. C. Hughes and A. C. Robbins. It includes the use of the telephone, and is said to have many improved features rendering it specially adapted to small cities and villages.

TAYLORVILLE, ILL.—The Taylorville Electric Company has an incandescent electric lighting plant and supplies steam heating by means of the system of the American District Steam Company. It has two 80 h. p. Ideal engines and two 125 h. p. tubular boilers. F. W. Anderson is president; D. D. Shumway is treasurer, and J. N. C. Shumway is secretary and manager.

MR. C. C. HASKINS, one of the oldtime telegraphers, for some years a telephone electrician, and for the past thirteen and one-half years City Inspector of Electric Lights in Chicago, having severed his connection with the municipal government, has established himself as an electrical expert, in Room 623, Western Union Building. Mr. Haskins' experience in handling electricity has been extremely varied, and extends over the greater portion of his life.

TACOMA, WASH.—The street car companies on the Pacific slope are said to be having trouble through the breaking away of many of their men for the Klondyke gold fields.

MR. CHARLES H. WILSON, formerly of the Chicago Telephone Company, has been appointed general manager of the Southern Bell Telephone and Telegraph Company.

KANSAS CITY, MO.—The president of the Northeast Electric Street Railway proposes to have the fares collected hereafter in boxes.

ST. PAUL, MINN.—The trustees of the State Insane Asylum have awarded the contract for an electric light plant to the General Electric Company for $17,200. The contract includes two dynamos, a Gates engine and wiring the hospital for 1,600 lights.

GENEVA, ILL.—The residents of Lake Geneva, Ill., are disturbed by the project of the Harvard and Lake Geneva Electric Street Railway Company, and it is said, that the authorities of the Yerkes astronomical observatory also object very decidedly on account of possible interference with the sensitive instruments employed.

ROTH BROS. & CO., Chicago, have just installed for Mr. John M. Smyth, a dry goods merchant of the West Side, a neat plant for 30 lights on board the steam yacht "Loreto," at Lake Geneva, Wis. The equipment consists of a 3 h. p. Roth bipolar slow speed dynamo driven by a Dake engine, and all the necessary paraphernalia for a complete lighting plant. The "Loreto" is 70 feet long and has engines of 150 h. p., and is one of the handsomest launches to be seen on the Western lakes.

JACKSON, MICH.—The Parrish Signal Company, to make crossings for steam and trolley roads, has been formed, with a capital stock of $100,000, the devices being those of H. H. Parrish. The president of the company is E. S. Hobbs; vice-president, C. C. Bloomfield; secretary, L. B. Trumbull; treasurer, E. D. Warner. The factory will be at Jackson.

MR. W. B. McDONALD, superintendent of the People's Light and Power Company, Chicago, has devised an arc lamp hanger board made entirely of glass, having a glass back, or support, as well as glass insulating knobs. This device, known as the McDonald Glass Hanger Board, can always be relied upon as a perfect insulator, and always looks bright and clean. This specialty is being placed on the market by the Electric Appliance Company, Chicago, who will be very glad to quote prices on application.

FORT WAYNE ELECTRIC CORPORATION will, according to current rumors, build electric street railway apparatus.

PHILADELPHIA NOTES

EPHRATA, PA.—The borough council has awarded the contract for lighting the streets with twenty 3,000 c. p. long burning arc lamps, to run until midnight, at $65 a year, to F. E. Bailey, of Philadelphia. A company has been organized and a site secured for the location of the plant, and work will be commenced at once. The plant will have a capacity of thirty arc lights and 1,000 incandescents.

ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, have closed a contract with the National Electric Car Lighting Company to furnish them with storage batteries, and will at once equip fifty cars at Atchison, Kan.

KEYSTONE ELECTRIC COMPANY, of Erie, Pa., F. B. Downing, president, write us that they have closed a contract recently with the McAdams & Cartwright Elevator Company, of New York, for eleven 20 h. p. and three 5 h. p. electric elevator outfits. These will be installed in a large new Broadway building.

"THE PLUNGER," a submarine boat on the lines of the "Holland," recently described in The Electrical Engineer, has just been launched for the Government from the works of the Columbian Iron Works, Baltimore. She can dive 20 feet in 10 seconds.

PULLEN BATTERY AND ELECTRIC MANUFACTURING COMPANY, of Camden, N. J., has been formed, to make reversible primary batteries and other apparatus. The capital stock is $100,000. The incorporators are L. W. and J. M. Pullen, of Camden, and C. L. Klander and A. E. Bainbridge, of Philadelphia.

EARLY TELEGRAPHY.—The Philadelphia, Reading and Pottsville Telegraph Company has just celebrated the fiftieth anniversary of the sending of the first message over its lines. It was chartered March 15, 1847, and it claims to be the oldest telegraph line in the United States.

HAGERSTOWN, MD.—It is said that the men on the Hagerstown Electric Road are kicking not because of overwork, but because they have to wear high collars all the time, summer as well as winter.

NEW YORK NOTES

NEW YORK CITY. The Metropolitan Traction Company has bought the branch of the Union Railway Company's system, running by trolley on One Hundred and Thirty-fifth street to Madison avenue bridge, and it will convert it into a conduit system, connecting with the Lenox avenue conduit road and giving rapid transit all over the west side for one fare of five cents.

SHEEHAN & HEWITT, electrical engineers and contractors No. 40 South Water street, Newburg, N. Y., will hereafter act as selling agents for the C. & C. Electric Company through the central, northern and western counties of New York State.

BROOKLYN, N. Y.—A fatal accident occurred at Ridgewood Park on Sunday, August 1, when F. McDonald, riding his illuminated bicycle on a tight rope charged from the trolley circuits, fell 75 feet to the ground and was killed. His sensational act was described in The Engineer some time ago, and it is remarkable he should have gone on so long without accident. It is said his foot slipped from one of the pedals.

SARATOGA, N. Y.—The Saratoga Gas, Electric Light and Power Company are rebuilding and rearranging their gas plant, and have let the contract for the steel work connected with the generator house roof and the roof over their cold storage building to the Berlin Iron Bridge Company, of East Berlin, Conn. The roofs have steel trusses covered with corrugated iron.

DOLGEVILLE, N. Y.—The Electric Light and Power Company have contracted through G. W. Pulver & Co., Syracuse, N. Y., with the Westinghouse Electric and Manufacturing

Company for two 450 k. w. two-phase alternating current generators, one 250 k. w. rotary transformer, exciters and a large marble switchboard, together with a number of transformers for lighting and motor work. The generators will be connected to Victor turbines running at 300 revolutions per minute under 72 feet head. The rotary transformer will deliver direct current at 600 volts for the present direct current motor service in use in various manufacturing establishments. The alternating current generators are of 7,200 alternations.

EASTERN ENGINEERING COMPANY, of New York City, has been formed to carry on a general mechanical and electrical engineering business, with a capital stock of $5,000. The directors are F. E. Tyng, Elizabeth, N. J.; F. R. Haines and S. T. Tyng, New York City.

JOHN WENNSTROM COMPANY, Forty-first street, Brooklyn, N. Y., manufacturers of jewel bearings, report their factory busy on some good orders.

SCHMINKE & NEWMAN, 325-27 Baroune street, New Orleans, have secured the contract for the electrical work for the new St. Charles Hotel annex, in that city. The new iron-armored conduit manufactured by the Interior Conduit and Insulation Company, of New York, will be used throughout the work.

NEWARK, N. J.—That was an excellent suggestion of Superintendent Reilly, of the New York and New Jersey Telephone Company, in reference to the color of the poles. The Common Council had a clause in its ordinance requiring all the telephone poles to be painted white above 8 feet from the ground. This would make them about as conspicuous as possible, while Mr. Reilly suggested that dark green or olive would be far better. The sensible nature of the suggestion commends it to all.

PALMYRA, N. Y.—The Palmyra Electric Light and Power Company are extending their system and are in the market for wire, street lighting fixtures and general material. They say that there is an opening in the vicinity for an electric road.

NEWARK, N. Y.—At the recent outing of the Consolidated Traction Company's employés at Bergen Point, Conductor Mike Carroll was accompanied by his valet, E. Blanchard, who carried a dress suit case for him.

ELECTRIC HEADLIGHTS are reported to have the advantage not only of illuminating the track far ahead, but of disturbing by the brilliancy of their beam any animal that may be sleeping or lying down on the track; thus preventing collision or derailment.

POSTAL TELEGRAPH COMPANY has laid complaint before the State Railroad Commissioners, against the Mobile & Ohio road, in Tennessee, for discrimination in distributing Western Union poles but refusing to handle any for the Postal Company.

NEWBURG, N. Y.—The Consolidated Gas, Electric Light, Heat and Power Company is going to put in the Holly system of exhaust steam heating. Pipes will be laid in a large number of streets. The system is that of the American District Steam Company, of Lockport, N. Y.

THE NATIONAL TELAUTOGRAPH COMPANY is pushing the Gray invention again with improved and perfected mechanism. Gen. T. M. Logan is president of the company, and J. W. Johnston, general manager.

JAMAICA, W. I.—The West India Electric Company, Ltd., is being formed at Kingston, Jamaica, with a capital of $1,-250,000 to operate electric tramways. Those interested are S. C. Burke, L. Verley, R. J. Macpherson, P. E. Auvray, S. L. Schloss, W. Andrews and A. R. Saunders, who are connected with the present mule street railway.

MR. LAFOREST TRUE, of Clinton, Fairfield, Me., has bought machinery for the equipment of a plant for the manufacture of electrical supplies. He is now beginning operations.

ELECTRICITY IN JAPAN.

A correspondent of an electrical manufacturing concern writes from Tokio, Japan, saying: "Since October last a number of electric light companies have been started here. Several mines are endeavoring to get their power transmitted distances of from five to seven miles, using 2,000 to 3,000 volts, and utilizing water power. The Hiroshima Water Power Company is going to buy at first three 250 k. w. tri-phase generators, with step-up and step-down transformers. The Hiroshima plant will be the first Japanese long distance power transmission scheme involving a 10,000-volt circuit. The Japanese government for some time past has been busily engaged in extending telephone exchanges and in starting long distance telephones. Solid back transmitters, multiple switchboards and telephone cables are required, and the American manufacturers, it is thought here, could meet British competition."

AHLM-EDWARDS PLANTS.

The following is a list of recent orders received by the Ahlm-Edwards Electric Company, of Cleveland, Ohio:

One 17½ k. w., 125 volt, 825 r. p. m, generator for Chase & Sanborn, Chicago; one 7½ h. p., 500 volt, 1,400 r. p. m. elevator motor and one 15 h. p., 500 volt, 1,200 r. p. m. elevator motor for Edmonds Elevator Company, Cleveland, O.; one 5 h. p., 220 volt, 1,000 r. p. m. elevator motor for the Enterprise Printing Company, Cleveland, O.; one 3 h. p., 220 volt, 1,100 r. p. m. motor for W. Plotz, Cleveland, O.; one 42 k. w., 250 volt, 850 r. p. m. generator for the Enterprise Boiler Company, Youngstown, O.; one 7½ h. p., 220 volt, 700 r. p. m. elevator motor for the Britton Printing Company, Cleveland, O.; two 1 h. p., 220 volt, 1,300 r. p. m. motors and one 2 h. p., 220 volt 1,200 r. p. m. motors and two 3 h. p., 220 volt, 1,100 r. p. m. motors for the A. S. Gilman Printing Company, Cleveland, O.; two 1 h. p., 220 volt, 1,300 r. p. m. motors and two 2 h. p., 220 volt, 1,200 r. p. m. motors for the Britton Printing Company, Cleveland, O.

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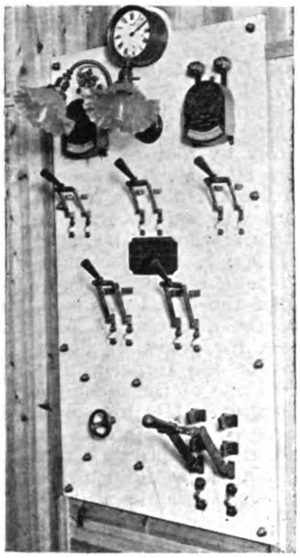
The Electrical Engineer.

VOL. XXIV. AUGUST 26, 1897. No. 486.

ELECTRIC LIGHTING

AN INTERESTING ISOLATED PLANT AT YOKOHAMA, JAPAN.

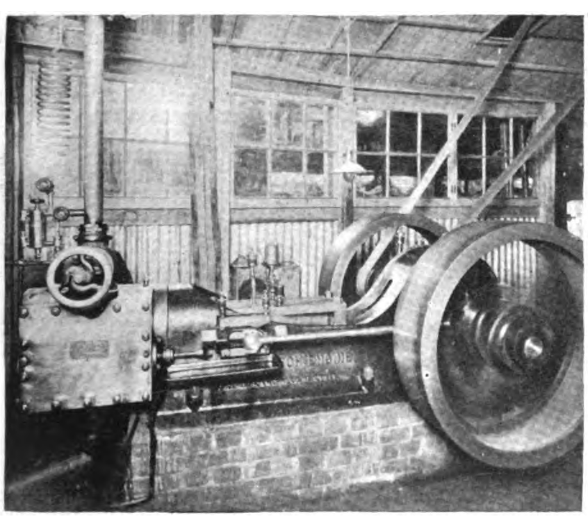
BY LAMAR LYNDON.



Japan-Made Switchboard.

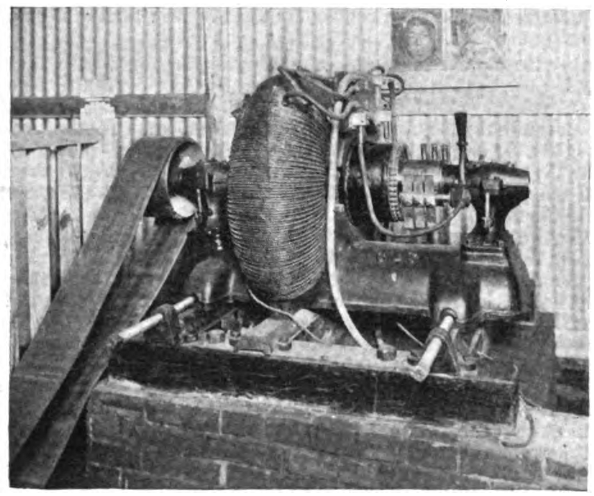
THE following description of a small isolated lighting plant recently installed in Yokohama may be of interest, because of the fact that it is, so far as the writer can ascertain, the only private plant ever installed for the purpose of lighting the same class of establishment, i. e., a tea firing "Godown."

As is well known, the principal product exported from Japan and China is tea, and at most of the ports of these empires there are large eseablishments for the "firing" or "curing" of this leaf. This raw tea is put through several processes of cleaning, sifting and assorting, with the aid of homely, native-made machines, which consist essentially of an arrangement of sieves agitated in any of usual mechanical methods, with fan-blowing attachments. The tea is then carried to the firing room, which is equipped with rows of iron pots, about 26 inches in diameter, set in brickwork, underneath which a slow fire is kept going. A coolie, either male or female, attends each pot, stirring the tea continuously, so that it is thoroughly roasted. An idea of the extent of this industry may be gained, when it is stated that a reasonably large tea firing godown, contains about 1,500 of these pots, and that they are kept going night and day during the shipping season. One of the largest companies in Japan, engaged in this business, is the firm of Messrs. Averill



ISOLATED GENERATING PLANT IN A YOKOHAMA TEA FACTORY.

& Co., of Yokohama. They employ over 2,000 people in the busy season, and their firing rooms, warehouses and sifter rooms are quite extensive. Up to the beginning of the present season, they have obtained their current from the local electric company, and their bills were discouragingly large. Moreover the steam engine they were then using to drive the sifting machinery was a most extravagant steam consumer. It was an old 10-inch by 16-inch slide valve engine made in Tokyo several years ago, and running 60 revolutions per minute, or 160 feet piston speed, which necessitated plenty of steam, and a corresponding amount of coal, to get any power out of it. This combined expense of coal and light was so considerable that the Messrs. Averill finally called in the writer to make such changes and additions to the steam plant as were deemed necessary, and to install in conjunction therewith, a complete electric plant. Accordingly, a contract was entered into with the American Trading Company, of Yokohama, this company agreeing to import and install the necessary equipment and guarantee the satisfactory operation of same. The boiler then in use, which was made in England and is of the Lancashire type, being in an excellent condition, it was decided to retain it. The old engine was torn out, and in its place was installed one of the modern high speed en-



ISOLATED GENERATING PLANT IN A YOKOHAMA TEA FACTORY.

gines, built by the Phoenix Iron Works Company, of Meadville, Pa. The size is 8 inches by 10 inches, and it runs at 350 revolutions per minute. It is equipped with a "Rites" governor, which is extremely sensitive. It is impossible to observe any speed variation with change of load, though a chronograph would probably indicate a slight fluctuation.

Many years ago, the spot on which Yokohama now stands, was a marsh, which was gradually filled up as the settlement increased in size. Consequently it is some trouble to get a good foundation in many parts of the city, and so it was in this case. However, it was not practicable to drive piles, and so the next best thing was resorted to, namely the excessive spreading of the foundations as they went down, thus making up in area what they lacked in solidity of bearing. This was done in the case of both the engine and the dynamo foundations. They were built of brick, laid with a mixture of best Portland cement and sand, in the proportion of 2½ parts of sand to 1 of cement. The piping from the boiler to the engine is of best extra heavy 2½-inch pipe, having all joints flanged, and all bends made of lengths of the same, bent to proper curvature. Just over the engine is a 2½-inch vertical Cochrane steam separator, which delivers absolutely dry steam to the steam chest. The exhaust pipe, which is 3 inches in diameter, rises to a height of 10 feet, and enters a feed-water heater of the closed type. This heater was made by a Yokohama firm—Peterson & Co.—and consists of a shell having inside top and bottom plates, into which are fastened by screw ferrules, 100 copper tubes ⅞ inch in diameter. The exhaust passes through the tubes, and the feed-water around them. A top and bottom blow-off relieves the feed-water of scum and sediment, and the water enters the boiler at about 210 degs. F., and practically free from scale-forming material. A drip in the bottom of the heater clears it of all condensed steam. This heater is hung from the roof truss by four ⅞ inch rods that pass through proper plates in the roof and through lugs bolted to the bottom of the heater. Water from the city waterworks is used, passing through a Cameron boiler feed-

pump, by means of which it is forced through the heater into the boiler. All the piping, even down to the ½-inch steam pipe to the feed-pump, is extra heavy and connected with flanged couplings and long bends. All drips are piped together and run into a common drain pipe leading to the sewer. It was not considered desirable to further complicate this small plant by any steam traps or drip return systems.

Some trouble was experienced in piping the pump and engine, owing to the fact that all pipe threads in these machines were, of course, cut to the American standard, while all the tools in use in the shops in Japan are English standard. In some cases new flanges were made and in others the pipe ends were cut on a lathe to fit the American threads.

The dynamo is of the medium speed bipolar type, made by the C. & C. Electric Company, of New York. It is of 16 k. w. rated capacity at 125 volts, and is compounded for a 4 per cent. rise on full load. It is equipped with the usual ring oilers and spherical socket journals, and has operated perfectly without any hitch or trouble from the day it was started. It is mounted on a heavy brick foundation that rises 15 inches above the pavement of the engine room. On top of this are the base frame and sliding rails, which raise the machine 5 inches more, making the bottom of the dynamo 20 inches above the floor line. This was considered desirable on account of the tea dust, that settles down and floats about close to the floors. This tea dust is very penetrating and manages to get into the engine room, though it is tightly closed by wooden partitions.

The switchboard is made of a single slab of white marble, 2½ by 5 feet. On it are mounted three 30-ampere and two 50-ampere feeder switches and one 150-ampere main dynamo switch, made by Eyanson & Armpriester, of Philadelphia; a C & C back connected rheostat and an ampere meter made by the Western Electric Company, a double lamp bracket, which was made in Tokyo, and a copper encased clock, which was of Swiss manufacture. The board was made by the Japan Marble Company from sketches made by the writer, and for their first attempt is a very creditable piece of work. All connections are made in the back, and none of the wiring is visible from the front of the board. The slab is mounted on an angle iron framework, being fastened thereto by eight ⅜-inch steel studs, having an ordinary nut and washer on the back and with a thick beveled washer and cap nut of copper in front. The studs holding the rheostat to the board are furnished with washers and nuts of the same kind, which give a handsome finish to the board. In order that the slab might have an even bearing surface against the framework, strips of rubber ¼ inch thick, and the width of the angle bar, 2½ inches, running the entire length of the board, were interposed between it and the iron. There are two vertical angle bars forming the frame, to which the slab is bolted, one on each side. At their lower ends they are bent back at right angles to the vertical, and extended back about 30 inches and bolted to an iron plate, 36 inches by 30 inches, this plate, of course, being in a horizontal plane. A foundation was built, covered with cement, and the plate set on it. Then the brickwork was continued upward to the level of the engine room floor, leaving the plate firmly imbedded. This method of placing in position is permanent, secure and independent of any alterations in the walls or partitions of the building.

The connections from the dynamo to switchboard consist of two lead-covered cables of approximately the same area as No. 000 B & S, from the dynamo terminals to the main switch, and two No. 12 B & S rubber-covered and braided wires from the field coil terminals to the rheostat. These are carried in a small underground conduit of brick and cement, the small wires being separated from each other and from the cables by insulating knobs strung over them at intervals. After the conductors were placed in the conduit, it was filled with melted rosin, which entered every crevice, and hardening, formed a perfect insulator and protection from moisture.

The connection with the city lighting company's mains was retained, a breakdown switch being installed at the meter, and not on the switchboard, as is usually customary. The peculiar and Japanesque arrangement of the interior wiring made this advisable.

Some trouble was experienced at first in getting the Japanese engineer in charge to operate the plant properly. The old engine had run at the deliberate pace of 60 revolutions per minute, and 350 was too speedy for his mind to grasp. Consequently, he throttled the engine down to about 200, at which speed the governor is inoperative, and the dynamo cannot be brought up to voltage. It was some time before he could be induced to open the throttle fully, and then he did it with a sort of an "I-know-what-will-happen-but-if-you-insist-on-being-a-fool-you-take-the-responsibility" air, and I think he was really surprised that the whole thing didn't fly to pieces. However, as soon as he saw that it went all right at the proper speed and was taught how to bring the voltmeter pointer to the right position by turning the rheostat handle, he immediately developed into an electrical engineer of deep and profound wisdom and resource, and was quite willing to furnish any desired information to the contracting and installing engineers, and would, no doubt, have so favored the builders of the machinery had they been accessible. However, this "breed" is well known in the United States, and the vexatious side of the question there is that the majority of people know so little about such matters that they cannot see through the bluff and pretentions of these "sogenannten" engineers, who usually are possessed of about sufficient information and intelligence to engineer the motive power of a one-horse plow. However, there are many good, practical and well informed engineers in Japan, and they are doing excellent work.

In this connection I may mention the fact that the matter of distribution of power in mills and factories is being taken up with considerable interest. Some of this work has been done in a desultory way in one or two of the government arsenals.

To the Nippon Shario Kabashika Kaisha (anglice, "Japan Railway Car Building Company"), of Nagoya, however, belongs the honor of first placing a complete plant of this kind in which all the power of the engine is converted into electrical energy, and distributed entirely by motors. The entire equipment is of C & C apparatus, an 80 k. w. slow speed multipolar generator, and a number of bipolar motors being used. A battery of chloride accumulators will supply light to the offices at night. The selection of this method of transmission is due to the persistent efforts of Mr. I. Hattori, the chief engineer of this company, who has long recognized the superiority of electrical transmission over the usual methods, and has labored unceasingly to induce the directors of his company to adopt it. Mr. Hattori was, for years, in charge of some of the most important shops of the Imperial Government Railways, and is recognized as one of the most learned and progressive engineers in the empire. His approval will undoubtedly do much to advance electrical interests in this field in Japan, and it is to be hoped that American apparatus will hold its own in the Far East, notwithstanding the strenuous efforts of the English, Swiss and Germans to supplant it with their own products.

LIGHTING THE NIAGARA UNIVERSITY WITH ACETYLENE GAS.

BY ORRIN E. DUNLAP.

It is probable that the largest buildings in the United States, if not in the world, now lighted throughout by the new illuminant, acetylene gas, are those of the Niagara University and Seminary of Our Lady of Angels, at Niagara Falls. This well known educational institution is located on the bank of the Niagara River, just beyond the northern boundary of Niagara Falls, and being in a somewhat isolated spot, so far as the modern facilities of cities are concerned, it has for years maintained its own gas plant. This plant was of the crude oil variety. The college buildings are very large, and from October to April about 2,000 feet of gas is consumed every night. The crude oil gas was found satisfactory, and had been in use since 1870, but, owing to various circumstances, a change was deemed advisable. With this object in view, Rev. Father Hayden was authorized to install any system of light he felt would be satisfactory. Father Hayden had been impressed with the value of acetylene, and in order to get more knowledge of its efficiency as an illuminant he visited Philadelphia. A trip to Philadelphia increased his confidence in acetylene, and on his return home he made contracts for the installation of a plant for the college. This contract was made with the F. W. Oliver Company, of Ni-

NIAGARA UNIVERSITY, LIT BY ACETYLENE.

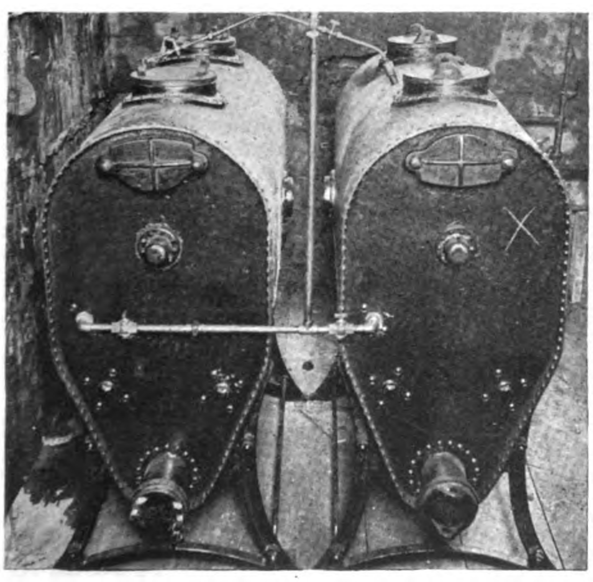
agara Falls, and the plant was installed under the supervision of William Erskine.

On the college grounds, standing about 100 feet from the main buildings, there is a stone building known as the gas house, and it is in this building that the acetylene generators are placed. They are two in number, of the Dolan pattern and automatic in their workings. A ½-inch pipe runs from the gas house to the college buildings, and it is through

Gas House, Niagara University.

this pipe that the supply passes. The buildings were already piped for gas and changes were necessary only in the style of burners. The burners in use are of the half-foot variety. Of these there are 197 in the main building, 34 in the chapel, 12 in the printing office, 40 in the postoffice building, and 4 in the engine room, or 287 in all. Under the crude oil system of lighting they, heretofore, had 32 lights in the study room, but these have been replaced by eight acetylene lights, on which shades have been found necessary owing to the brilliancy.

The college was founded in 1856. The attendance of students each year is very large. It stands among the leading colleges of the country, and the adoption of acetylene has attracted no little attention. The carbide being manufactured at Niagara Falls by the Acetylene Light, Heat and Power Company, the supply is very convenient. Before the door of the gas house are to be seen two of the drums in which the carbide is packed, each drum holding about 1,100 pounds. Heretofore it was necessary to employ a man for making



Two Acetylene Gas Generators, Niagara University.

gas, but under the acetylene system installed, the only requirement is that somebody shall visit the gas house once a day and turn the wheel that agitates the carbide in the generator, so that gas will be generated. It is calculated that the cost of maintaining the acetylene plant will be about one-third of the cost of the crude oil plant. The new installation has been in service a short time, and has given highly satisfactory results. It will not be surprising to hear of other large isolated buildings in Western New York adopting the system. Much interest has been displayed in the Niagara University plant, and people from quite a distance have made it a point to see it. Almost every night the college has visitors to see the new light, but the courtesy of the reverend fathers is unfailing.

EDUCATIONAL

THE COURSES IN ALTERNATING CURRENTS AT THE UNIVERSITY OF WISCONSIN.

BY PROF. DUGALD C. JACKSON.

TWELVE years ago a half-dozen young men graduated from electrical courses in the engineering schools of the country. There were then but two such courses—one at Cornell University and one at the Massachusetts Institute of Technology—and these had been founded almost simultaneously during the college year 1882-83. The first graduates from each course left college in June, 1885; four from one college and two from the other. It was some years before the initiative of these colleges was followed by others, but we now find the electrical engineering course generally given a position in the engineering schools, which is equivalent to that held by the courses in civil engineering, mechanical engineering and mining engineering, and there are no less than a dozen engineering colleges at which a dozen or more students graduate each year from the electrical engineering course.

The early formal courses in electrical engineering differed very materially from those of the present time, and the differences may be largely traced to the differences in the extent and complexity of the profession as practiced then and now. The early courses made much of telegraphy and telephony; not too much, indeed, but very much in contrast to the attention then given in the courses to the heavier applications of electricity, such as electric lighting, transmission of power and railways. Several divisions which now constitute highly important parts of the curricula in electrical engineering were entirely wanting in the early courses. No fixed instruction on the theory of the magnetic circuit and the magnetic properties of iron, with appilcations to the dynamo, for instance, was introduced for some time after 1885. In fact, our present views of the magnetic circuit may justly be said to have become generally diffused only during the present decade. Neither were courses in alternating currents or applied electrochemistry found in the early curricula. The latter, even now, does not receive the attention that it deserves, but the former has come to hold an indispensable place in all thorough college courses in electrical engineering.

The early development in the applications of alternating currents was brought about through the most arduous experimenting, while little or no safe theory based on the underlying or fundamental facts of the phenomena involved had been developed in a manner which might enable it to serve as a guide to the extending of known results, or the obtaining of new ones. The essentials were doubtless all to be found expounded within the covers of Maxwell's "Magazine of Electrical Facts and Theories," and probably elsewhere, but the application of these expositions was not readily perceived, and, in fact, is often quite obscure. A decade of experiment of the part of constructors and of study on the part of theorists has now given us a sound foundation of accumulated facts upon which to erect satisfactory theories which may be directly applied to problems relating to alternating current phenomena and to the construction and operation of alternating current machinery.

The use of alternating currents in commercial ventures is so extended that an adequate course in the theory and practice in alternating currents and the construction of alternating current machinery and plants is an essential part of all reasonably complete college courses in electrical engineering; while the knowledge which is now had of the subject makes it possible for satisfactory instruction to be presented.

The question of text-books on this subject has been a matter of much difficulty in the past, but there are now several books of a more or less satisfactory nature which deal with the general subject or its various ramifications, between which a choice may be made. The most important class room course in alternating currents at the University of Wisconsin comes in the regular senior year of the electrical engineering students and follows Jackson's "Alternating Currents and Alternating Current Machinery." This book, in fact, puts in type the alternating current instruction which has been presented

at Wisconsin for several years past. The complete instruction in alternating currents at Wisconsin includes a course which is more advanced than that given to the seniors, and which is presented to graduate and special students who have satisfactorily passed through the senior work or its equivalent.

A text-book which appeals to me as eminently fitted for this advanced course has lately appeared in Steinmetz's "Alternating-Current Phenomena." I have tried various books as the text in this work, including Thomson's "Polyphase Electric Currents," "Courants Polyphasés," by Rodet et Busquet, and "Courants Alternatifs Industriels," by Loppé et Bouquet, and have been forced to abandon them all as entirely inadequate for the purpose. Steinmetz's book, however, seems to be well planned for the purpose. The only reasonably available book on the subject besides Steinmetz's, which I have not tried, in this advanced class, is Kraemer's "Der Drehstrom," and that lies under the disadvantage of being printed in the German language—a disadvantage which is insuperable in the case of the class composed of mixed college graduates.

The fact that calculus is supposed to be excluded from Steinmetz's book has led some to believe that it should make a satisfactory first text-book in the subject of alternating currents for the electrical course. Such an idea takes entirely too much for granted, however, and it appears to me as unavoidable that any class of college students who enter upon the subject with the assistance of this book will obtain, as a whole, a remarkably foggy and distorted idea of the subject of alternating currents; unless, perchance, the teacher adds by way of explanation, illustration, and design so much material that the labor becomes equivalent to that of writing his own text-book. On the other hand, as said above, the advanced student with a good knowledge of alternating currents can use this book with much advantage.

"Alternating Currents," by Bedell and Crehore, which is used as a first text-book in the subject in some colleges, has given me no satisfaction whatever. Its study does not place before the student's mind any idea of the engineering features of alternating currents, though it doubtless does give him training in mathematics and experience in resolving differential equations; but the latter appears to me to be the matter of least importance in the study of alternating currents. Mathematical skill is convenient, but a real physical conception of the phenomena dealt with is the essential to be sought after first, last and all the time, and all other considerations must be subsidiary. With Jackson's book as the first text-book and Steinmetz's book as an advanced text, students can be brought with considerable ease to what appears to be a good physical knowledge of the phenomena of alternating currents and their applications, including the construction and operation of alternating-current machinery and plants. No other texts have given what seemed to be reasonably satisfactory results in my classes.

I hope that the distinguished authors of these various books, each of which has many admirable points, will not take umbrage at my frank statement of experience.

In connection with the text-book instruction, we give, at the University of Wisconsin, a thorough elementary course of laboratory instruction in alternating current measurements and the testing of alternating current machinery, which holds in the alternating current course a place which is similar to the place of the laboratory course in either of the other important branches of electrical engineering. This laboratory work has three objects in view: 1. To illustrate and reinforce the class room instruction and give the student a vivid physical conception of alternating current phenomena, which it cannot be hoped that he will get from class room instruction alone. 2. To give the student a working idea of the magnitudes of impedances, inductances (self and mutual), capacities, etc., which are to be met with in actual machines and circuits. 3. To illustrate the methods of operating alternating current machinery and show the way to make complete tests on the same, with instruction in the use of the special instruments which may be conveniently used.

The fixed list of experiments used in the alternating current laboratory contains about seventy-five numbers, varying from those which are very simple to those which are quite complex. In the course of regular undergraduate work no student has enough time to assign to this work to enable him to accomplish more than half the experimental work represented by the list; but the assignments of experiments among fixed groups of students are attempted to be made so as to give to each individual in the group a representative series, while the entire group, the members of which work to a certain degree in consultation, covers the ground of the whole list to a fair conclusion. Special emphasis, however, is laid in the undergraduate course on the first sixty numbers of the list.

To set forth the entire list of experiments in this article is scarcely desirable, but the following examples will illustrate the list. The numbers given show the numerical order of the experiments in the laboratory list and the page references refer to Jackson's text-book.

1. Measure impedance of inductance coil when connected to 50-volt and 100-volt circuits (frequencies of 125 and 60), using amperemeter and voltmeter. Measure resistance. Plot vector diagrams and determine values of reactance and inductance. Pps. 90 and 161.

2. Measure impedance, using amperemeter and voltmeter, of coil of low inductance and coil of high inductance in series, when connected to 50-volt and 100-volt circuits (frequencies of 125 and 60), at the same taking readings of the pressure across the terminals of each coil individually. Plot vector diagrams and get values of total reactance; resolve into constituent triangles and determine values of individual reactances of each coil. Pps. 90 and other.

4. Measure impedance of condenser when connected to 50-volt and 100-volt circuits, using amperemeter and voltmeter (frequencies of 125 and 60). Determine value of capacity, assuming power absorbed to be negligible. Pps. 81 and 165.

5. Measure impedance of inductance coil and condenser in series on 50-volt and 100-volt circuits (frequencies of 125 and 60). Plot diagrams and determine reactances. P. 171.

(The apparatus issued to students for use in the preceding and similar experiments must, of course, be properly chosen, so that, for instance, the opposing effects of inductance and capacity will be plainly evidenced.)

7. Determine exact value of self-inductance of a long solenoid, for use as a standard: (a) Calculate from windings and measured dimensions. P. 42. (b) Measure by method of Maxwell and Rayleigh. P. 93. (c) Measure by method 3a, using variable inductance box. P. 98. (d) Measure by method 4a, using Marshall divided microfarad as a standard. P. 103. Scrutinize the results and compare the accuracy and convenience of the methods.

9. Determine curve showing variation of self-inductance of transformer secondary with saturation of core. Use method 4b for inductance measurements and magnetize the core by passing a continuous current through the primary coil. P. 104.

10. Measure self-inductances of armature and fields of continuous current dynamo with fields unexcited, using method 3a or 4b. Pps. 104. Repeat measurements of armature self-inductance when fields are fully excited. Pps. 104.

11. Measure self-inductance of alternator armature in various angular positions by methods 1 and 3a, the fields being unexcited. Pps. 90 and 104.

12. Repeat, with fields fully excited.

13. Measure working self-inductance of alternator armature when carrying full load current and with fields excited to full value, three-fourths value, one-half value by method 1. P. 90.

15. Measure self-inductance of alternating current voltmeter and calculate the effect of frequency on its indications. Use method 2a. Pps. 93 and 16.

16. Calibrate the same voltmeter and experimentally determine the effect of frequency upon its indications.

18. Calibrate an indicating wattmeter and experimentally determine the effect of frequency on its indications when used with a non-inductive load.

19. Measure self-inductance of pressure coil of wattmeter used in 18, calculate correction factor for non-inductive load, and compare with the results of 18.

21. Determine external characteristic of alternator with non-inductive load. P. 272.

22. Repeat, using inductive load.

23. Repeat, using a capacity load (increase effect of condensers, if necessary, by means of a step-up transformer).

25. Determine form of alternator pressure curve by ballistic method and deduce magnetization curve. P. 289.

32. Determine form of pressure curve of city lighting circuit, using synchronous motor to drive contact maker.

36. Determine form of current curve in series field of composite alternator.

37. Bring two alternators to equal pressure and synchronism, then connect them in parallel. Alter the belt speed of one machine, a known small amount by means of the friction cone pulley, from which it is driven and measure the synchronizing current. Repeat the operation until the synchronizing current becomes equal to the full load current for the machines. Plot results so as to show the relation between the difference of the driving speeds of the machines and the synchronizing current. Pps. 329 and 341.

38. Synchronize and connect in parallel two alternators of equal pressure, and determine the effect on the synchronizing current of decreasing the field excitation of one. Pps. 329 and 362.

39. Synchronize and connect in parallel two alternators of

equal pressure and throw the belt off one. Determine the load (as a motor) at which the free machine breaks from synchronism.

40. Repeat with an inductance coil in the armature circuit of the free machine.

(It is desirable to use alternators of from 3 to 10 kilowatts' capacity for the experiments on alternators, or one such alternator may be used in connection with a fixed current supply from a large machine. Either arrangement is used at the University of Wisconsin as convenience dictates.

44. Measure mutual inductance of transformer coils: (a) By method 1. P. 407. (b) By method 2. P. 408. (c) By method 3a. P. 411. (d) Calculate self-inductance of each coil, assuming magnetic leakage to be negligible.

46. Determine forms of curves of primary and secondary currents and pressures and their angular relations in a transformer with no load and with full load, using contact maker and electrostatic voltmeter.

47. Determine regulation curve (P. 490), curve showing variation of magnetic leakage with load (P. 496), and curve showing variation of power factor with load (P. 497) for a transformer.

48. Measure iron losses in transformer core by the three voltmeter method and compare with wattmeter measurements. P. 125.

51. Efficiency test of transformer by Sumpner's method (method 8a): (a) Measure iron loss by wattmeter, correcting to standard pressure. P. 485. (b) Measure copper loss by wattmeter, correcting for residual iron loss. P. 486. (c) Calculate quarter, half, three-quarter and full load efficiencies. Plot curve. P. 485. (d) Calculate all-day efficiency on basis of five hours full load and 19 hours no load. P. 492.

52. Measure efficiency of fully loaded transformer on non-reactive circuit using wattmeter in primary circuit and amperemeter and voltmeter in secondary circuit. P. 382.

53. Measure losses due to hysteresis and Foucault currents in transformer core, using wattmeter, and separate them. P. 500.

55. Determine hysteresis constant of iron sample by means of Ewing hysteresis tester.

56. Measure loss due to dielectric hysteresis in condenser and calculate the effect of this loss on condenser current and apparent capacity.

59. Determine curve showing relation of armature current to excitation of synchronous single-phase motor, and find excitation for maximum power factor. Pps. 580 and 582.

60. Determine efficiency curve of synchronous single-phase motor by wattmeter and prony brake.

62. Determine efficiency curve of polyphase induction motor by wattmeter and brake measurements. Pps. 560 and 653.

64. Determine power factor curve of polyphase induction motor from no load to full load. P. 654.

67. Determine efficiency, power factor, and transformation ratio of rotary transformer.

69. Measure efficiency and ratio of transformation of experimental transformer for transforming from three to two phases.

70. Measure phase angles on primary and secondary sides of transformer for phase transformation.

71. Determine forms and relative positions of pressure waves on the two-phase and three-phase sides of phase transformer.

The list illustrates the progressive nature of the laboratory instruction. The student's level of view is first lifted out of the plain of Ohm's fundamental law into the mountains of its generalization, and after he has gained a true understanding of the significance of the simpler phenomena of the alternating current circuit he goes progressively into the experimental study of the alternator, transformer and motor of the single-phase circuit and finally the more complex machinery of polyphase types. The latter experiments cannot be fully covered during the time which it is possible to allot in the undergraduate course, even to this important subject, especially as the proper solidarity of treatment demands that much emphasis shall be laid on the earlier experiments relating to measurements in alternating current circuits, testing of alternators, testing of transformers, paralleling of alternators and the action of synchronous motors. It is hence necessary to leave the greater part of the laboratory work relating to polyphase machinery till a graduate year. A certain amount of the latter can, indeed, be done in the undergraduate course, but this must be all of the most elementary character, such as making simple measurements of power in polyphase circuits of different character, testing rotary transformers, phase transformers, etc. There is each year at Wisconsin a class of graduate students who have completed the first year's work, and who go ahead in the laboratory to the completion of the fixed list and often beyond.

The favorite subjects of study by graduate students in electrical engineering at Wisconsin have been alternating currents, theory of electricity and magnetism and applied electrochemistry, in about the order given; these subjects being under the direction of different teachers in the department.

Study in another direction—design—is, like work in the laboratory, necessary to a proper appreciation and understanding of alternating current machinery. Electrical engineering students in college should, of course, receive thorough instruction in draughting, kinematics and machine design; but special instruction is necessary to adapt the general to the special. So that draughting room designing of generators, transformers and motors is not only desirable, but essential. Computations relating to the design of alternating-current generators, with the exception of certain peculiar features, follow so closely the methods used in continuous current computations that special instruction in alternator design does not seem necessary except so far as relates to controlling the form of pressure wave, armature reactions and armature self-inductance—features which, at the best, are rather obscure. An allotment of time for the complete design of alternators therefore, appears to be unnecessary provided the alternating current instruction has been preceded (as is essential in a satisfactory course in electrical engineering) by a thorough and satisfactory course in electromagnetism and the design and construction of dynamos.

The design of transformers is in a different category, and the Wisconsin undergraduate students are all required to make at least one complete design of an alternating current transformer, following the very complete physical theories of the transformer presented in Jackson's "Alternating Currents," with dimensions checked by means of the empirical data presented therein (which was compiled from a large mass of constructive data of transformers of many makers), and also by comparison with the original data of numerous transformers, which is put in shape for use in the draughting room. The design of polyphase transformers and induction motors conjoins with the graduate course in alternating currents and is carried on therewith. It is entirely impossible to get it into the undergraduate course with the entrance requirements as they now stand in nearly all of our engineering schools.

There is much engineering matter bearing upon the use of alternating currents which does not relate directly either to alternating current theory or alternating current machinery, but does relate to the transmission and distribution of electricity. So much of this may be treated in common with the transmission and distribution of continuous currents that it seems best to include the work with the instruction in electric lighting, electric transmission of power, and central station management, rather than to burden the alternating current instruction with matter which must be given general treatment in any event when dealt with under the above divisions. By this means duplication of instruction is avoided and the most advantageous use is made of all of the student's time. The arrangement thus set forth makes it necessary that instruction in electric lighting, electric transmission of power and central station management shall be contemporaneous or consequent to the instruction in alternating currents and not antecedent thereto, but this is the natural and logical order and would probably be chosen in any event.

A COURSE OF STUDY IN ELECTRICAL ENGINEERING.[1]

BY PROF. R. B. OWENS, UNIVERSITY OF NEBRASKA.

MY object in presenting the following paper is to call attention to the difficulty with which instruction in electrical engineering is kept abreast of the current development of the subject, and to point out certain expedients found useful, in this connection, in a school distant from the larger industrial centers, and in maintaining a sustained interest on the part of the student and fitting him more quickly for the responsibilities of engineering work.

The unparalleled growth of electrical industries in the past decade and their present increasing rate of development makes the task of bringing the school work to correspond to best engineering practice. seem an almost hopeless one. But unless such a correspondence does obtain, an injustice is done the student, at least if he is allowed to believe that the work he is doing is strictly professional work similar to the work done in the best schools of law and medicine.

To be sure it is contended by some that it is only within the province of the school to impart the broader principles that underlie engineering in general and its several branches in

[1]Read before the Society for the Promotion of Engineering Education.

particular, but a careful study of the possibilities of technical training very clearly shows that much of the time now spent by the student in learning to apply general principles might be saved if in the last year or two of study he is brought into closer relation with the methods and practice of our more successful makers and best constructing engineers.

I do not wish to be understood as saying that all the details of dynamo manufacture, street railway construction, etc., can even be touched upon in a course in electrical engineering. Such details vary so rapidly as to make it impossible for a school to follow them, even if it were advisable. However, it is generally known, outside of the schools, that little information of real value relating, for instance, to dynamo design, not electric and magnetic theory on the behavior of particular dynamo machines, is obtainable in the greater number of courses in electrical engineering in this country. Such a condition when looked at fairly is readily explained. The men who to-day are successful designers of dynamo machinery and builders of electric lighting and railroad properties that pay, are so constrained by business relations as not to be able to conduct college work and college men when summer comes take refuge as a rule in the country rather than in a shop or factory, and so begin their autumn work with small additions to a usually scant fund of practical information.

However, the electrical manufacturer and lighting and street railway managers are generally glad to assist the schools, as many who have received courtesies at their hands can testify, and if close relations between the school and practice do not obtain it is the fault of the college man. In short, the college man should work as hard during his so-called vacations in collecting material for the coming season's lectures as he does during the scheduled period for conducting classes. The instructor in electrical engineering has, of course, the newness of his subject as a special difficulty to contend with, but if the practice is followed of visiting every year the plants of the manufacturing companies, typical lighting and power stations, etc., information is obtained which cannot at present be found in engineering literature, and which has the highest value for instructional purposes. In engaging an instructor in technology it should be with the understanding that cultivating close relations between college work and outside practice is a part of his duty and a limited consulting practice when not conducted to the injury of the practicing engineer should be encouraged.

I have adopted the following practice in teaching dynamo design: First, the student is drilled in the theory of electromagnetism and the magnetic circuit and is then required to fill out in detail the same data sheets that are used by our best manufacturing firms, for a number of machines of which working drawings are available. I find this especially useful in giving the student an idea of the porportions which do obtain or have obtained between the parts of single machines. Next curves and tables are made, showing the variations in the principal proportions of machines of different types and sizes. This gives the student an idea of the change in particular proportions with conditions of service and output. Necessarily the data possessed by a technical school is not of the latest, but supplementing it by the information secured each summer, a very close approximation to correct practice is obtained.

Having worked over all the material available, the present tendencies in dynamo design are pointed out as well as can be and explanations given. Then a line of machines for certain assumed conditions is decided upon and each student takes one machine. The work after this is largely at the drawing board. The advantage of having all students working on machines of the same type, but of different dimensions is, that by comparing notes they are able to see clearly the necessary change in dimensions as the output, etc., of the machines varies.

A line of standard D. C. and A. C. machines are always required, and special machines, if time allows. All drawings are made uniform and complete data sheets filled out for each machine. Next the data and drawings are submitted for criticism to some one whose business it is to design machines to maintain the reputation of and earn an income for those who invest their money in the manufacture of electrical machinery. In this way it is attempted to give the student salable information without sacrificing principles to unnecessary detail.

Lectures on electrical lighting, street railways and general installation work are supplemented by a required design of a lighting or railway plant. A number of scale drawings of towns of various sizes are available and from known or assumed conditions the station is located. Then, if it is a lighting plant, the location of individual consumers is assumed with particular load diagrams for each. From the individual load diagrams the nature of the station load is determined and the machinery and circuits laid out. All circuits are calculated and shown on the map together with poles and important accessories. Setting plans for standard machinery are readily obtainable and the station arranged accordingly. This is, of course, the ordinary preliminary survey of the consulting engineer. Next, full specifications for the plant are drawn definite as regards results to be obtained but impartial as regards standard apparatus. Well drawn sets of similar specifications are, of course, available to the student and criticised for his benefit.

Lastly, a bill of material is made and costs are worked out for some one type of standard machinery from price lists and labor estimates, and the cost of operation and maintenance and necessary income determined to make the plant a paying investment. Such station plans and estimates are then checked by a constructing engineer, whose routine work keeps him directly in touch with such matters.

The tendency to carry system to an extreme in some engineering laboratories is greatly to the student's disadvantage. If on entering a laboratory a student is met with a long list of inconsequent experiments, handed a batch of laboratory forms and told to begin observations with apparatus already set up by a laboratory assistant, his interest in research takes rather a sudden fall. Having explained the use of instruments, the general methods of dynamo testing and the peculiarities of particular machines, better results are obtained by turning over to a group of students a dynamo with necessary testing apparatus and letting them work out results as far as possible unaided. Care must be taken, however, to point out the tests that have a commercial value.

After having equipped a dynamo laboratory with machines of standard type to furnish current in necessary quantity and at convenient voltage I believe the remaining space should be filled with what in effect are simple testing blocks. Then as new machines come upon the market they can be borrowed, tested and returned, giving new apparatus for investigation without finally making a junk shop of the laboratory.

I believe very thoroughly in the value of a thesis requirement for undergraduate technical work. It is not expected that such theses will develop new principles in engineering as some seem to expect, but very much valuable data as to the various types of new apparatus continually coming out is obtained, and the student learns to assume responsibility by being in a large measure left to his own resources.

Another expedient of utmost importance in bringing schools of electrical engineering into close contact with current development is that of having specialists in the several fields of practical work give courses of lectures detailing the status and probable development of their work. One lecture by a distinguished engineer, while it interests for an evening, does not meet the requirement. I find courses of about ten lectures to cover satisfactorily such special topics as the design and construction of power plants, electric measuring instruments, etc. On these courses of lectures the student should be examined as upon work given by the ordinary instructors. So long as instruction in electrical and other special branches of engineering cannot in general be preceded by longer courses of preliminary training due to the pressing demands for technical information made by the recent enormous growth of our industrial interests, the granting of a full engineering degree for the ordinary four years of college work seems unwarranted. The recent graduate is not an engineer; we only hope he has the capacity to become one. A safer course, and one which I have adopted in granting the degree of Electrical Engineer, is to require certain additional or graduate work after the bachelor's degree, and the full degree is conferred at any subsequent time when the applicant presents a dissertation showing that he has actually planned and carried out electrical work of some importance. If such a practice were general, I believe the degree would secure more attention than it does at present. A continued effort should also be made to raise the entrance requirements to engineering courses. This will finally be effective I think in bringing the special branches of engineering into our graduate schools along with other strictly professional work.

A LIST of saloons and messenger companies which have wire connection with houses of ill repute has been forwarded to the St. Louis City Lighting Department, and a gang of men will take down the wires. The list was prepared by the police, in response to a request made by the City Lighting Department. A city ordinance says that no such telephonic communication shall exist, and it is proposed to enforce the law. It is shown in this report that the Cable Messenger Company has forty-six signal boxes in houses of this class, while the Eureka Messenger Company has thirty, and the Western Union Telegraph Company has forty-one boxes.

MISCELLANEOUS

ROTARY TRANSFORMERS.—III.

BY C. F. SCOTT.

(Concluded.)

SUMMARY of Characteristics of a Rotary.—A rotary acts both as an alternating current motor and as a direct current generator and has the following characteristics:

(1) The machine is similar to an ordinary synchronous motor in its dependence upon the wave form and the e. m. f. of the circuit to which it is connected and upon the speed of the generator. A circuit which is variable in speed or in e. m. f. may produce an unstable condition in a rotary, which tends to produce a mechanical oscillation or "pumping" action. This may be so slight as to cause no practical inconvenience, or it may be sufficient to cause periodic sparking of an injurious amount or a fluctuation in the e. m. f. delivered, or it may be so great as to prevent the mechanical running of the machine.

(2) Rotaries are of two types, the direct current field rotary and the induction rotary. The former type requires a much more careful adaptation to the circuit on which it is to be operated, and is much more sensitive and liable to disturbance in its operation than the induction rotary, although its successful operation in service proves that there is no question as to its commercial success. The induction rotary is a simpler and cheaper machine to construct and to operate; it possesses many advantages over the first type and can in general meet all conditions more successfully, except those requiring considerable compounding, especially with variable loads, and for operation of large sizes on high alternation circuits.

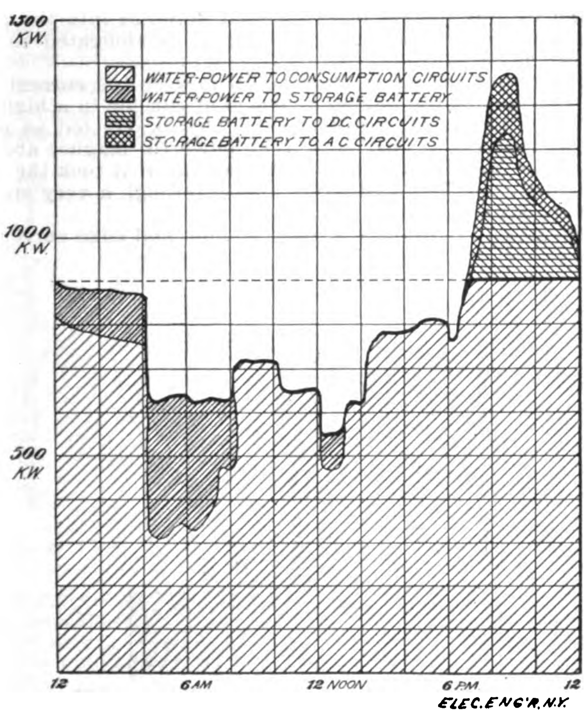


FIG. 13.—LOAD DIAGRAM AT HARTFORD.

(3) With the same output the loss in the armature conductors of a rotary is less than it is in a direct current machine; therefore, if the loss be kept the same the output of a machine of given size can be increased. In a three-phase rotary the output can be increased about 30 per cent. and in a two-phase rotary about 60 per cent. over the output as a direct current machine, the loss being the same and the efficiency consequently increased.

(4) The current in the armature of a rotary is distributed in such a way that there is little current in the conductors in front of the pole faces, thus avoiding the distortion of the field magnetism, which is common in direct current machines. This enables the machine to commutate a larger current and renders it less sensitive to changes in lead of the brushes. It also reduces the loss in the armature iron.

(5) The e. m. f. delivered by a rotary may be varied over a wide range by adjusting the alternating e. m. f. delivered to it, and it may be varied to a slight extent through proper compounding of the field or setting of the brushes.

(6) The e. m. f. for which a rotary can be constructed depends upon its frequency and the greater the number of poles required for a given speed. On a 3,000 alternation circuit a machine will run at 700 revolutions if it has four poles, while on a 7,200 alternation circuit there must be ten poles for a speed of 720 revolutions. The brushes on one machine rest on the commutator at four points, dividing it into quadrants, while on the other machine they divide it into ten parts, so that if the commutators be of the same diameter the distance between brushes is much less in the high alternation machine. The number of commutator bars and consequently the e. m. f. which can be commutated is also less.

As the size of the commutator is limited by the peripheral speed, it is evident that the greater the number of poles the less is the e. m. f. for which a machine can be built. If the number of alternations remains the same, it is not possible to increase the number of commutator bars by changing the number of poles. For if the number of poles be made half as great then the number of brush holders is correspondingly reduced, but the diameter of the commutator must also be reduced in the same proportion in order to maintain the same peripheral speed. This makes the distance between neutral points on the commutator the same with the fewer poles.

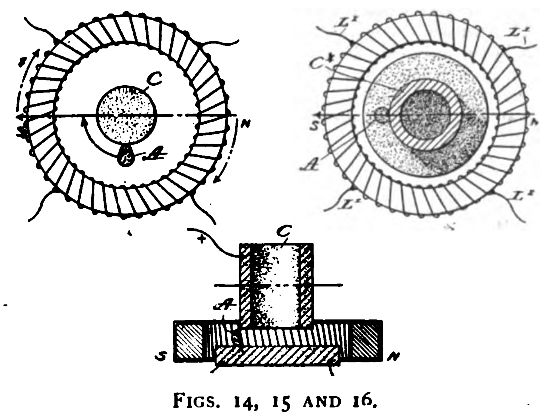
The author then refers briefly to the employment of rotaries at Hartford, Niagara and Buffalo, showing the great flexibility obtainable by their employment. Fig. 13 is a curve showing the load diagram at Hartford, where rotaries charge storage batteries. The latter have enabled a maximum load of nearly 1,500 k. w. to be handled by a water-power of 900 k. w.

ELECTRIC FURNACES.—III.

BY LIEUT. F. J. PATTEN.

(Concluded.)

FIG. 13, page 180, shows in cross-sectional elevation a furnace constructed on plan of using a continuous current between electrodes and an alternating field. The lower electrode, C^2, is given a slanting position, so that material between electrodes will slide, or flow down, its surface from right to left, while the arcs between the several upper electrodes and the lower one are traversing back and forth from one side of the magnetic field, N S, to the other, thus maintaining practically a sheet of electric flame, through which the material must pass.



FIGS. 14, 15 AND 16.

The rotary or revolving arc systems are illustrated in Figs. 14 to 18, inclusive. The principle used is plainly indicated in Fig. 14, in which C represents the horizontal projection of the lower carbon electrode and A is the arc. The arcing space is surrounded by an iron ring, in which a rotating magnetic field is set up by introduction of multiphase alternating currents to its continuous Gramme winding. The interior of the ring is, therefore, a magnetic field, which is continuously revolving in the plane of the ring and consequently the arc, A, in its endeavor to keep out of the magnetic field is rapidly revolved around the carbon electrode.

Various are the methods of applying this principle; two will

be briefly described. In one, Figs. 15 and 16, a hollow tubular carbon, C, is used for an upper electrode and a flat disc or slab for the lower one. The upper tubular carbon can be availed of as a feeding pipe to supply the material to be treated to the arc, which latter, owing to the moving magnetic

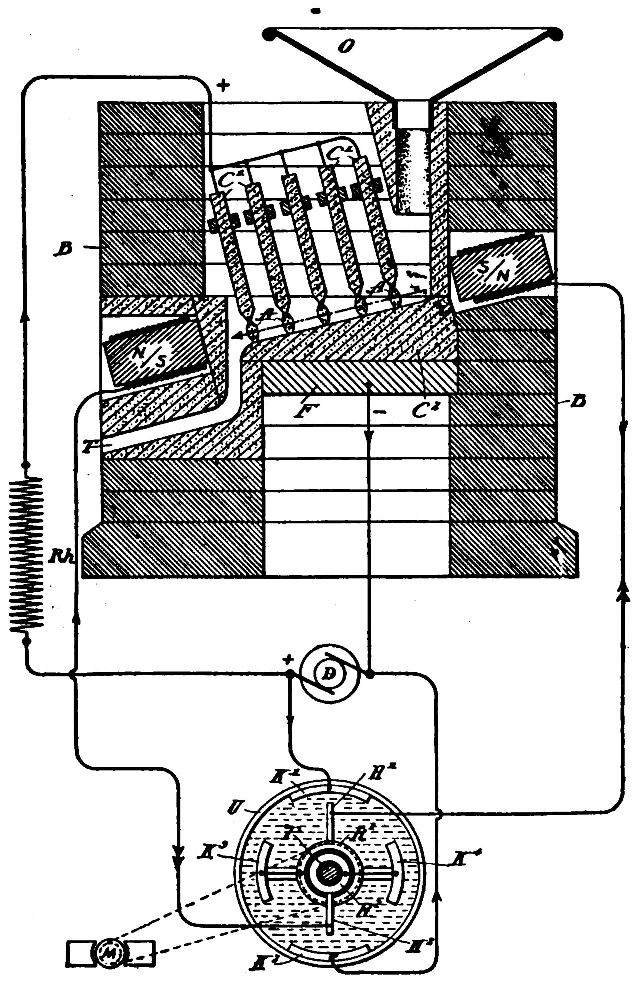
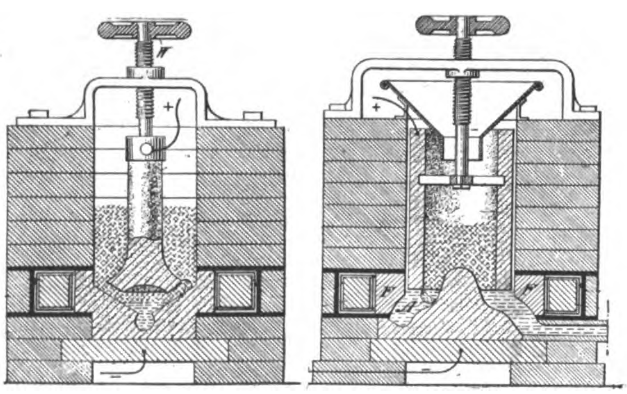


FIG. 13.

field in which it is placed, continuously revolves around the lower edge of the upper carbon tube or pipe.

Figs. 17 and 18 show furnaces built on these principles, one having a solid carbon electrode and a carbon furnace floor for the lower electrode, and the other a tubular upper electrode serving also as a feeding pipe for the furnace and a carbon floor piece for bottom electrode as before. In both Figs. 17



FIGS. 17 AND 18.

and 18, illustrating these furnaces, the magnetic ring surrounding the arc space is shown in section at N S.

It only remains to describe the rotating current, or revolving current incandescent system, as it might properly be styled, presenting as it does a means of causing the working current after having fused the carbon pencil of the ordinary incandescent system, before referred to (Fig. 7), to revolve, an axis of revolution remaining always on the outer surface of the molten or fused mass. In this way it is made to continually attack new material just outside the surface of the nugget already formed, and which compared with the lime and coke mixture is a good conductor.

The chief defect in the incandescent or pencil system lies in the fact that after the carbon pencil is fused and a nugget or pencil of carbide has been formed in its place, this prism of carbide in the fused state is a fairly good conductor, much

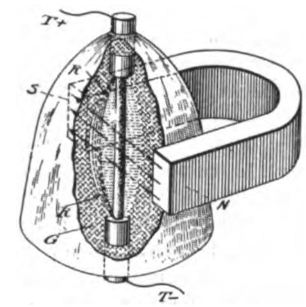


FIG. 19.

better, in fact, than the surrounding mixture. The result is, the current rushes through this sort of short circuit and is wasted, doing, of course, little or no work after it has once fused the mixture to carbide. At this stage of the operation the carbons are drawn further apart, so as to increase the resistance by introducing more unfused material into the path of the current. In this way the nugget is elongated to the limit of the furnace.

In the rotary current system I aim to keep the current out on the surface of the nugget or pencil of carbide in a high resistance path of unfused mixture. This is effected as indicated in Fig. 19, by placing a very powerful magnet around the path of the current, so that the current, if it took the normal or direct path, would have to pass through a very strong magnetic field.

In Fig. 19, G represents a mass of lime and coke surround-

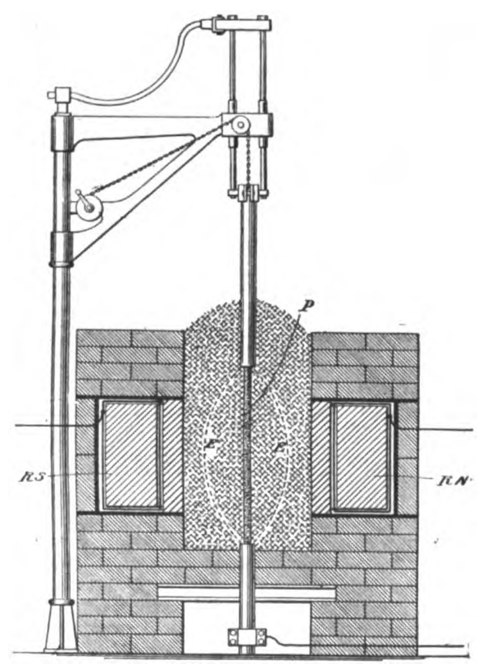


FIG. 20.

ing the carbon pencil and N S is a magnet, the poles of which surround it. When the pencil has been fused the current will then take the curved path between electrodes indicated by R, R, instead of passing in a direct line from one electrode to another, as it would do under normal conditions. Of course, in practice permanent magnets are not employed, but a magnetic ring is used as in the rotary arc furnace.

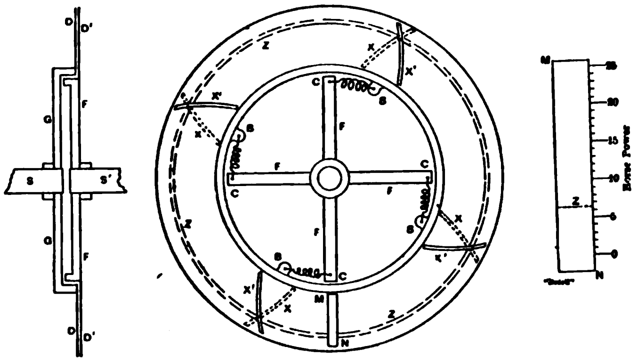
A vertical section of such a furnace is shown in Fig. 20. The magnetic ring, R N, R S, is shown in section, its intense magnetic field surrounds the working current or pencil or

prism of carbide, as it may happen to be, from one step to another of the operation. The ring is excited by multiphase alternating currents of very low periodicity, so that there will be a powerful and slowly revolving magnetic field through which the working current will be passing at right angles. This will cause the current to abandon the direct path across from carbon to carbon and to take a curved path as indicated by the dotted lines in the figure. But as the field is slowly revolving the current, like the arc, in its endeavor to get out of the magnetic field, will also revolve, describing an ellipsoid of revolution on the outer surface of the molten mass. In fact, it should go out as far as there is a conducting path for it. In this way it is designed to keep the current at work on new material continuously and build the nugget out laterally as well as longitudinally. It is almost obvious that if this plan is practicable on a very large scale, it will add greatly to the economy of the incandescent method.

THE BEDELL TRANSMISSION DYNAMOMETER.

AT the recent meeting of the American Society of Mechanical Engineers, Prof. R. H. Thurston described a transmission dynamometer designed by Dr. Frederick Bedell, which has been used for some years in a different form in experiments upon synchronous motors. The instrument has given such satisfaction that the application of the principle to the transmission dynamometer is advocated.

The dynamometer is shown in Figs. 1 and 2, which have been drawn to show the relation of the parts rather than the



FIGS. 1, 2 AND 3.—BEDELL TRANSMISSION DYNAMOMETER.

actual construction of the instrument. The shafts, S and S′, are the two shafts between which the power is transmitted; these are arranged in line and with ends abutting. The shafts are connected by any convenient system of springs; this system may consist of a single spring or a number of springs, which may be either for tension, torsion or compression. The annular disc, D, supported by the frame, G, is carried by the shaft, S. A similar disc, D′, supported by the frame or spider, F, is carried by the shaft, S′. In the particular form shown, the frame, G, carries four lugs, B, which are connected to the spider, F, by the springs, BC, which may be either springs for tension or compression.

Let us suppose that we have the shafts, S and S′ running, let us say, at a constant speed and with a variable load; that is, the shaft, S, is transmitting an unknown and varying amount of power to the shaft, S′. When the shafts are idle they have a certain angular position with relation to each other. When they transmit power, however, the shafts depart from the zero position with reference to each other by an angle which depends upon the strength of the springs and the torque between the two shafts.

In the disc, D, are slits, X, X, X, X; corresponding slits, X′, X′, X′, X′, are in the disc, D′. These slits are slightly curved, as shown in Fig. 2, the exact curvature necessary being explained later. The slits in one of the discs are the exact counterpart of the slits in the other disc, curving, however, in the opposite direction. The slits thus superposed give a single point of intersection. As the shaft, S′, is turned through a given angle with reference to the shaft, S, the slits, X, shift with reference to the slits, X, and the point of intersection of the two slits is accordingly moved inward or outward from the center of the discs. The openings formed by the intersections of the slits will show a continuous ring of light, Z, if the discs are illuminated from behind. For a constant torque the position of this ring of light will remain constant. The ring of light will, however, move inward or outward as the torque varies.

The slits are made of such a curvature that the change in the radius of the circle of light, Z, is directly proportional to the change in the angle—that is, to the torque.

The instrument may be direct reading, and experience has shown the following form to be convenient. An incandescent lamp is placed behind the discs. This lamp is enclosed in a suitable opaque box so that it illuminates only the disc. In front of the discs is a stationary opaque screen covering entirely the whole apparatus. In this screen is a ground-glass window, MN (see Fig. 2). The incandescent lamp is behind the two discs and directly opposite this window. Instead of a complete circle of light, Z, we only see a line of light across this window.

The scale at the side of this window shows the horse-power direct for a given speed, as shown in Fig. 3. As explained above, the slits are made of such a curvature that the divisions of the scale in Fig. 3 are equal. The position of the line, Z, in Fig. 3 indicates 6.3 h. p. at a speed, let us say, of 400 revolutions per minute. When the speed is not maintained constant, it is necessary to determine the speed and to correct the reading accordingly.

TESTING PICTURES BY THE ROENTGEN RAYS.

A correspondent of the London "Elect. Rev." says: In the possession of Herr Friedrich Burger, of Munich, is a fine old painting of the Saviour crowned with thorns, which has been generally ascribed to Albrecht Dürer, though some critics had expressed themselves as doubtful on this point. In 1893 the Grand Duke of Baden had discovered after a long and careful search the monogram of Dürer, and determined the date 1521. As this discovery did not satisfy all the sceptics, the owner of the painting conceived the novel plan of submitting the painting to the action of the Röntgen rays. After many unsuccessful attempts, success was at last attained. The magical picture produced by the Röntgen rays excited the greatest interest and astonishment. The picture of the thorn-crowned Christ was exactly reproduced with correct light and shade, also the cross nimbus surrounding the head and marked above with the initials A and D. Moreover a signature was discovered in late Gothic characters, and Dürer's monogram with the date 1521 as had already been made out by the Grand Duke of Baden. The picture was painted on silk stretched on an oaken board 2 cm. thick, covered with interlaced oak fibres, and these are all shown distinctly in the Röntgen image. This application of the Röntgen rays may prove of considerable value to picture dealers and others in detecting fraudulent imitations of valuable paintings.

THE ROENTGEN RAYS AND CARDIAC AFFECTIONS.

Before the Congress on internal diseases, at Berlin, Germany, Prof. Benedict, of Vienna, stated that the most important result of the employment of the X-rays in this department of medical science had been the ascertainment of the strength and extent of the heart's movements in healthy and unhealthy conditions. They had shown that the work performed by a sound heart had been greatly over-estimated, and they had thus rendered the vibrations of a diseased heart easier to understand. Doctors were now in a position to learn the size and position of the vital organ in cases where the former methods of ausculation and percussion had afforded them no help. By the Röntgen rays it was possible to observe deterioration of the valves at a much earlier stage than previously, and to gain exact information as to the relations between the heart and the diaphragm, as well as to observe the movements of the membrane. In the early diagnosis of disease of the lungs, stomach, and kidneys, the rays rendered doctors important assistance; and it would in future be possible to gain a knowledge of diseases at a stage at which they had previously entirely escaped detection.

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THE FIRE ALARM TELEGRAPH.

THE past record of the fire alarm telegraph in this country might well be termed ancient electrical history, yet the highly important part which it plays to-day in conserving life and property well entitles it to a reminiscent glance, and this has been given in the admirably concise historical paper read by Mr. Adam Bosch before the American Institute of Electrical Engineers at their recent meeting at Eliot, Me. Mr. Bosch's contribution was particularly apropos to the occasion and place, as to no one more than to Moses G. Farmer was due the ultimate successful establishment of the fire alarm telegraph system. As early as 1845 Dr. W. F. Channing had publicly advocated the establishment of such a system in Boston and had, indeed, with wonderful prescience, laid down its general principles. Yet it required the unremitting labors of both Farmer and Channing for seven long years before a system was developed sufficiently reliable for public use. Even then all the troubles were not eliminated, but experience and the continuous vigilance of the gifted projectors finally brought about success. It must be borne in mind that these early systems all included the striking of great alarm bells, controlled by electrical mechanism. This is considered a simple matter at the present time, but at that comparatively remote period—Channing's first suggestion was made barely a year after Morse's first telegraph line between Washington and Baltimore went into operation—all these trifling details had to be worked out from the very beginning with absolutely no data to go by. Gamewell, who shortly after appeared upon the scene, had his attention first directed to the fire alarm telegraph by Prof. Joseph Henry, who had helped many another to achieve fame and fortune by his advice and counsel so freely given to all comers. Gamewell at once recognized the great importance of the fire alarm telegraph, and lost no time in acquiring the rights in all existing patents on the subject. Armed with these he gathered about him a corps of able electricians and mechanicians, among them Edwin Rogers, James M. Gardiner, Moses G. Crane and John Polsey, and together these men developed much of what is now standard fire alarm apparatus, or which formed the basis for it. Nor must the name of Charles T. Chester be forgotten, to whom is due the automatic alarm box, invented in 1856,—previous to that time all signals being transmitted by hand in various ways. The first "non-interference pull" was also due to Stephen and Charles T. Chester. Then followed invention after invention, including many for controlling the doors of alarm boxes so as to prevent mischievous interference, and a variety of others, relating to central office, and to engine house apparatus, the combined effect of which has resulted in bringing about the marvelous results in rapidity and precision of transmission of fire alarms now the pride of most American cities. Mr. Bosch is of the opinion that one of the problems in fire alarm telegraphy has not yet been satisfactorily solved, and that is, making the signal boxes readily accessible to anyone in case of fire, and in a way that will not at the same time render it easy to give false alarms. Thus even in this well worked field the ultima Thule has not yet been reached, and there is still chance for the aspiring inventor.

THE SUCCESS AND FAILURE OF SCIENTIFIC MEETINGS.

THE enterprise of the British Association for the Advancement of Science in crossing the ocean this year, appears to have been rewarded by a very successful meeting, the papers being good, the attendance large and the hospitality profuse. As at Montreal in 1884, so at Toronto in 1897, the Canadians have extended a hearty welcome alike to kin from across the sea and to kin from across the border, and the result will be a stimulus to scientific work in the Dominion and to general interest in it. As a matter of fact, England is not a little desirous just now, and wisely so, to cultivate her friendly relations with the big "colony"; and while some among us feel that Canada will never attain the full growth of manhood until it is independent and self-governing, there is no cause for regret in the prosperity of the Dominion under English rule and encouragement, and none in the stability of political institutions under which her people are happy, even if they do not increase in number very rapidly. It is not unlikely that the British Association is in Canada with a political arriere pensee, but that is its own business, and meantime it has attended assiduously to its chief object in life, the promotion of science under the British flag, with most undeniable vigor and success.

When we turn to the meeting of the American Association at Detroit and contrast its meagre attendance with the bustling crowds at Toronto, the contrast is a little too sharp to be altogether pleasing. It might be said that it was so small a gathering because many of the members preferred this year to go and meet their British brethren; but, on the other hand, it is small every year, and many of the British brethren were public spirited enough to go to Detroit. What is the reason for the general failure of the American Association meeting as a scientific and social function? Why should not the membership be as large and the attendance as good as with the British Association?

There are reasons, of course. This is a large country and a great many people cannot travel long distances for such a purpose, either because of the strain on health or because of the drain on pocket. But even the local attendances are not large, nor do the local notabilities turn in bodily and do all they can to give the stamp of society to the affair. It may be that the explanation is the absence of the wealthier people, who to-day are interested largely in culture and are college bred—at the seaside, on the mountains, or in Europe. We take it for granted that most of the big houses in Detroit, or Buffalo, or Washington are closed at this season of the year.

One fact that stands out prominently in the British Association meeting is that it rallies not only the grand body of

scientific talent where its strength lies, but the leaders who do most to give ideas, catchwords and data to the whole army of investigators. Now, without desiring to offer the slightest ground for offence, or to make invidious distinctions between great men and men not quite so great, we must say that the American Association somehow does not get all its big stars out. It is possible that the "star" idea is as much to be deprecated for a scientific meeting as for a theatre, but can it be said that the British Association meetings suffer in any sense from the active participation of those who loom as large in the public eye as do Lord Salisbury, Sir John Lubbock, Lord Kelvin, Lord Lister, and others who now are sharing busily in the work at Toronto?

Other scientific and engineering societies besides the American Association in this country appear to experience the same difficulty in getting out their leaders, so that perhaps the trouble is not one for which the association alone is to be criticised, as for an individual and curable weakness. To go no further afield than electricity, it may be noted that neither Mr. Brush nor Mr. Edison has ever shared in a meeting of the American Institute of Electrical Engineers, of which both are members; and yet that growing society, in influence, dignity and desire to promote a high standard is deserving of all the encouragement that personal presence can give. Prof. A. G. Bell has never attended a meeting, and when he was elected its president did not even take the trouble to prepare an address inaugural or otherwise. Mr. Tesla has given the Institute some magnificent contributions, but he rarely shows up at the meetings. Mr. Edward Weston was president, but has never, out of his inexhaustible funds of endless experiment and deep observation, made a single notable contribution to the transactions of the Institute. Prof. Elihu Thomson is the only man among the electrical leaders who can be counted upon as a steady and ever willing participant in Institute work. Yet when one turns to England, the proceedings of the Institution of Electrical Engineers are found to bristle with the names of well known leaders, and their interest in its work never flags. We fancy that a not dissimilar condition and comparison could be discovered in regard to other societies here and those abroad, but it should suffice to distinguish these two conspicuous examples. We think it would be really interesting and helpful to know why, in science and engineering generally, as shown by the facts to which we have drawn attention, there is less genuine solidarity and intercommunion here in democratic America than in a country like England, which we are apt to regard as aristocratic chiefly because it has a titled class. Is it that the leaders, as an aristocracy of intellect, desire to hold aloof, and prefer to do so, because they are leaders; or far more likely, is it that something is lacking in the work of such societies to bring these men in closer relations with them? No doubt the British Association has its own problems, but it does at least justify its existence by getting out the captains of science, who thus help it advance scientific work in public estimation by their names, by the lustre of their achievements and by their frequent presence at its gatherings.

INSTRUCTION IN ELECTRICAL ENGINEERING.

THE rapid changes which are constantly going on in what are termed the modern sciences and industries have now become so commonplace and are taken as such matters of course that they scarcely attract attention. Yet we find that even among some of the oldest sciences the changes are not less rapid and almost revolutionary. Those who will take the trouble to inspect the work of an up-to-date public school and compare it with the work of a generation back will realize the changes that have taken place in pedagogic methods during that brief period. Indeed, there is hardly a meeting of teachers at which there is not some scheme of teaching proposed diametrically opposite to what has been deemed good standard practice for many years past. An illustration of this diversity of views among educators may be distinctly traced in comparing the contributions by Prof. Jackson and Prof. Owens, which appear in this issue. On the one hand we note the laying out and adherence to what might be called a fixed course, so far at least as it refers to one department of electrical college work, while on the other the aim is to give the student as much latitude as is possible, and in a large measure to let him work out his own education, as it were. There are arguments that can be brought to bear in favor of both methods, and we will be glad to open our columns to a discussion of this subject in the hope that it may lead to the elucidation of the results attained by the differing methods adopted in our various colleges devoted to electrical engineering.

THE POSTAL IN MEXICO.

IT is a matter of more than usual interest that the Postal Telegraph Company should at last have made its way into Mexico, and in a very effectual manner. It is announced that the two great railway systems, the Mexican National and the Mexican Central have turned their telegraph lines over to the Postal people, and thus become essentially and integrally a part of an American telegraph system. The Postal Company has been building Southward for a long time past, to the Mexican border, with a view to the closing of the arrangement just mentioned. It is now in touch with the Mexican Central system at El Paso and will presently connect with the National system at Laredo.

As telegraphy to Mexico has hitherto been under Western Union control by means of the submarine cable, there will now be two good competitive services available to the American and Mexican public, and lower rates are in order. The message rate from New York City to the City of Mexico will be $1.85 for ten words, and the cable rate from the City of Mexico to London will be reduced from 60 cents a word to 39 cents. An increase ought to follow not only in the amount of telegraph business, but in those lines of trade affected favorably by quickness and cheapness of intercommunication.

FAN MOTOR FANCIES.

IT is reported that during periods of dullness on the stock exchange, the brokers have amused themselves by numbering the blades of their fan motors, and betting on the number to stop at a given point. This game, with interesting variations, has, however, died a natural death since business began to pick up, and the brokers are now occupied with the vagaries of "dollar wheat" and the ups and downs of the "industrials." We do not know that electricity has, in reality, suffered any loss by this diversion. The cool weather this summer, while a boon to most people, has certainly kept the fan motor trade from booming, and in view of the low range of the thermometer in July and August it is strange that inventive genius should have been bestowed on the problem of making the fan motor breeze any cooler than it would be naturally. But the fact is that one user of a fan has put his motor in an ice box so contrived that the air passes over the melting ice and is expelled by the fan through an opening in the side of the box so that a little ice goes a long way in the shape of an extremely cooling breeze. This reduction to a small scale of practice pursued elsewhere on the large is creditable and will doubtless be imitated by those for whom even this frigid summer has not been cool enough.

ELECTRIC TRANSPORTATION

ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.—IV.

BY PROF. S. H. SHORT.

(Concluded.)

MOTOR Best Suited to Elevated Service.—As there is neither dust nor water to contend with, the motor can be left entirely open, for the free circulation of air over the armature and field magnets, and not only thorough ventilation, but 20 per cent. more output, can be obtained from a given machine in this way. The open motor can be much more easily inspected and kept free from oil and grease.

The accompanying diagram (Fig. 17) shows the form of motor which we have designed for elevated railway service. This motor is intended to be taken apart by running the truck from under the car, and lifting the upper half of the magnetic ring by means of an overhead crane; this exposes the armature, left with its bearings in the motor frame, which is journaled to the car axle at one side and supported by the truck bolster at the other side. The motor frame has cast, integral with it, the lower half of the magnetic ring. Each half of the magnetic ring has two pole-pieces, wound with a few turns of heavy copper ribbon, so that the magnetic system of the motor is symmetrical, and of very large sectional area, to provide for the rapid acceleration control, which will be discussed later.

The magnetic ring is large in diameter and the axle is made to pass inside the ring, between the magnet coils, so that the distance between the gear centers is short. This makes the gears small in diameter, and gives a large clearance above the stringers inside the rails.

The armature is especially large and heavy, provided with deep slots to secure the bar winding, which makes but one turn per commutator bar. By this means the self-induction of the armature windings is reduced to a minimum, and there is a very low voltage between the commutator bars, providing for perfectly sparkless commutation.

Bronze is used for both the armature and axle bearings, and the lubricant is oil instead of grease. The brasses are so arranged that the thrust caused by the gears brings the shafts against solid unbroken surfaces. The oil is stored in cellars and is carried to the bearings by means of waste, which wipes the entire length of the shaft within the brasses.

Provision is made at the ends of the bearings to collect all of the oil which may escape and return it to the cellars to prevent a drip on the structure and street beneath. The bearings are made exceedingly long and the shafts are large in diameter, the pressure per square inch being reduced to the very low value of 37 pounds. The armature bearings are solid and are lifted out of the motor together with their oil cellars when the armature is removed by an overhead crane. The gear housing is made of heavy cast iron in halves, the lower half being permanently fastened to the motor frame, while the upper half may be lifted off independently by the overhead crane. The housing is grease-tight and the gears run in oil. The entire motor is cast from the best quality of steel.

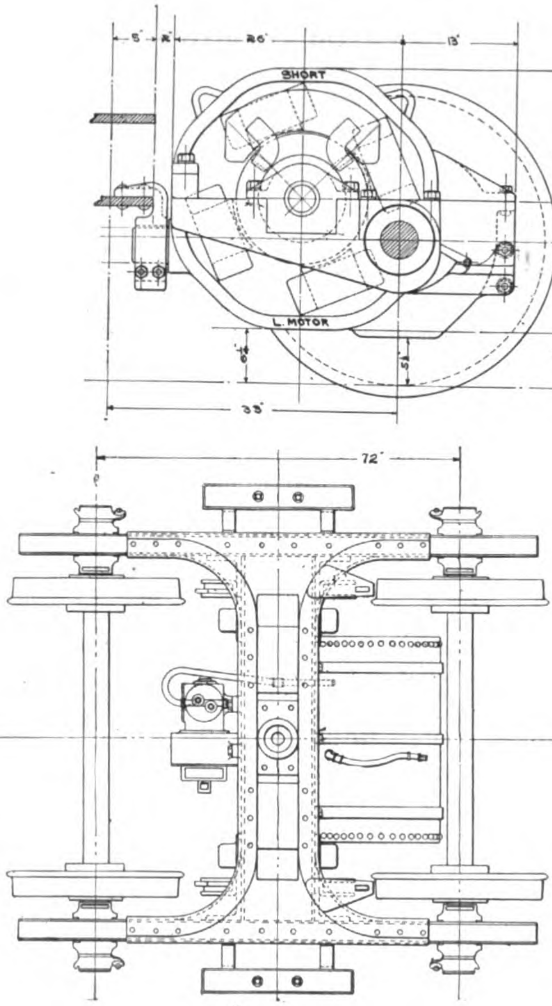


FIG. 19.

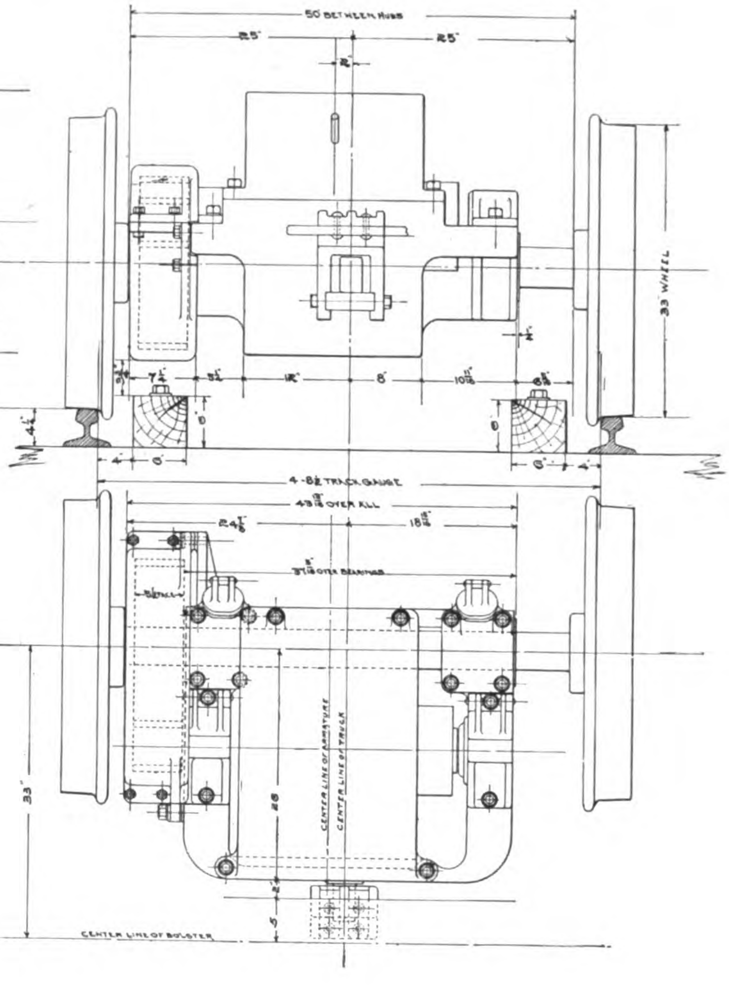


FIG. 17.

The Control.—The motors are controlled by a series-parallel controller, which provides for keeping a constant current through each of the motors, of such a quantity as will just avoid slipping the wheels during the time of acceleration. We have named this the maximum, constant current acceleration controller. In order to accomplish this kind of a control, the counter e. m. f. of the motors is prevented from rising until the train has reached the maximum speed at which it is desired to operate it. The counter e. m. f. is then

instantly raised to a point which reduces the current to a quantity which produces a horizontal effort sufficient to overcome the resistance of the train and maintain a constant speed.

The accompanying diagram (Fig. 18) shows the acceleration curve of an ordinary series-parallel controller and two series motors; also a curve of the constant current method of control, with two motors of the same size. The advantages of this latter method are apparent in the decrease of the schedule time and the decrease of power consumption.

The Brakes.—Westinghouse automatic air-brakes are used on all trains, with a brake applied to every wheel, enabling a train to be brought to a stop with a negative acceleration of 3 feet per second, which is not disagreeable to passengers.

The train pipe for this system of brakes is fed with air from a main reservoir attached to one side of the truck bolster (Fig. 19) of the idle truck of the motor car, as illustrated in the engraving. On the other side of the truck bolster is attached an electric motor air compressor, as illustrated. The motor is arranged to automatically stop and start under the influence of the varying pressure in the main reservoir. The object in putting the air-compressing apparatus on the truck instead of on the car body is to avoid the disagreeable noise due to the operation of the pump; and to facilitate repairs, as the truck with its entire air-compressing outfit is run out from under the car in the same manner as the motor truck.

Third Rail Feeder System.—A third rail of varying section should be mounted throughout the entire length of the road on substantial insulators. Heavy rails should be laid near the station and gradually taper off to the ends of the road. For most "L" roads it is not necessary to use auxiliary feeders of any kind, as the entire power necessary to operate all trains can be carried by the third rail. This rail should be placed on one side of the track with its head some inches above the track rails, so that sliding shoes, made of cast iron and attached to the trucks, may slide freely along their upper surface (Fig. 20).

The table (Fig. 21) below shows the amount of power which rails of different sections can carry, with a drop of 100 volts per mile, when all the power is delivered at the end of the mile. **Of course, the same amount of power can be distributed with the same drop over two miles of track. The table also shows the relative cost of this method of distribution as compared with copper feeders.**

Bonding.—All rails, as far as practicable, should be in 60 feet lengths. The third rail, as well as the track rail joints, should be bonded by a flexible copper bond, attached to the under side of the foot of the rail by means of a number of rivets, and the area of contact with the rail should be sufficient to provide that not more than 100 amperes per square inch should be required to pass through the joint between the steel and copper. The sectional area of the bond must be one-sixth the sectional area of the rail itself. The track rails should be electrically connected frequently with the elevated structure. Care should be taken that all joints between cop-

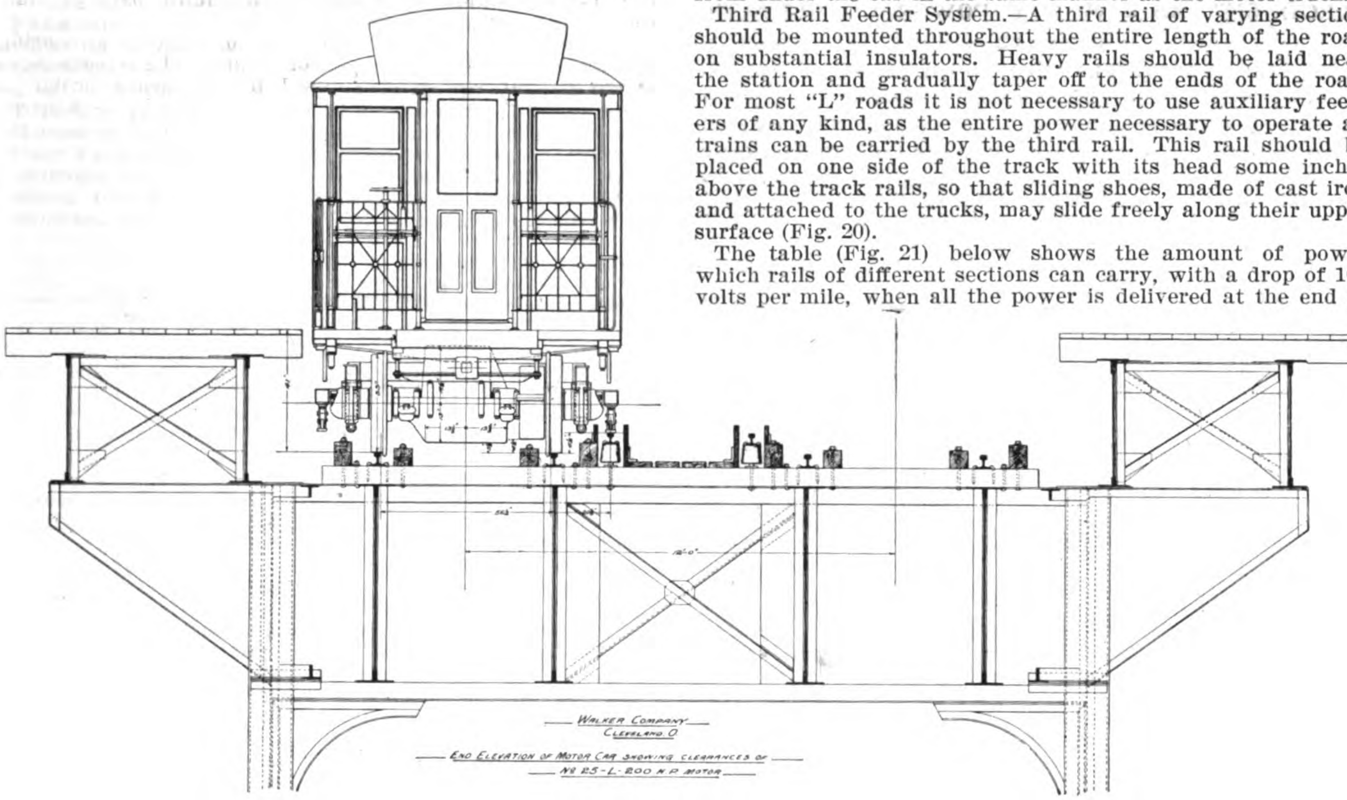


FIG. 20.

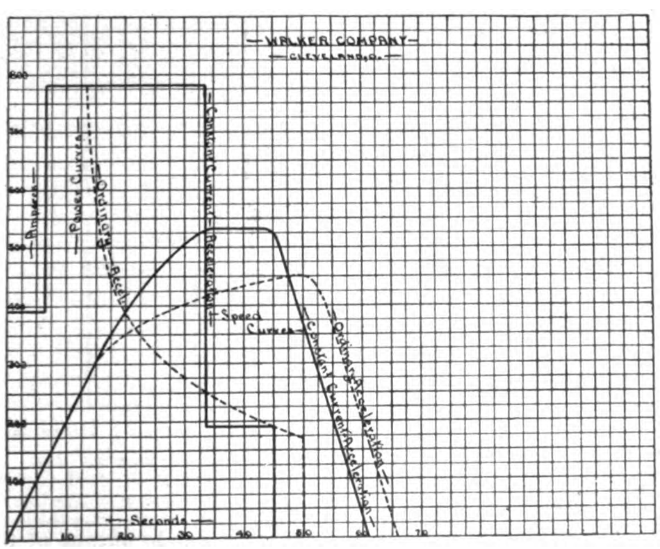


FIG. 18.

Comparative Table of Steel and Copper Feeders.

Steel Rails: Lbs per Yard	Steel Rails: Cost per Mile	Equivalent Copper Cable: C. M.	Equivalent Copper Cable: Cost per Mile	Current Transmitted 1 Mile 100 Volts Drop	Horse Power Transmitted
50	$774	910000	$2090	1640	1100
55	851	1000000	2300	1800	1210
60	928	1091000	2510	1970	1320
65	1005	1182000	2720	2130	1430
70	1110	1273000	2930	2300	1540
75	1188	1364000	3140	2460	1650
80	1268	1455000	3350	2620	1760
85	1450	1546000	3560	2790	1870
90	1535	1637000	3770	2950	1980
100	1705	1819000	4190	3280	2200

FIG. 21.

per and steel should be made with clear bright surfaces and no space be left to admit water or air to corrode the joints.

ELECTRIC TRAMWAYS WITH STATIONARY ACCUMULATORS.[1]

BY LUDWIG SCHROEDER.

IN February, 1896, an experiment was made on the Zürich-Hirslanden electric tramway to see if it were possible to connect the accumulator battery directly across the machine terminals without using the automatic cell switch. This trial proved very successful, and as a result the 270 cells have been connected directly to the machines during the last three-quarters of a year without any means of regulation other than that afforded by themselves. The connections are those shown in Fig. 1, and they are extremely simple. The voltmeter has been omitted so as not to confuse the diagram. The ammeter, A, is of the type with its zero in the center of the scale so that it indicates whether the cells are charging or discharging.

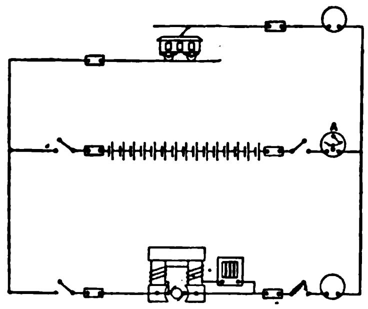


FIG. 1.

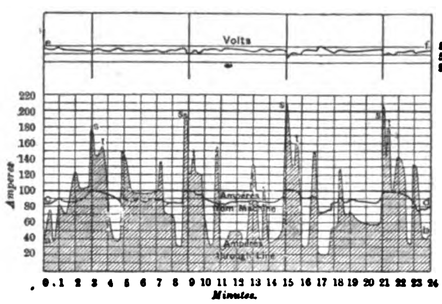


FIG. 2.

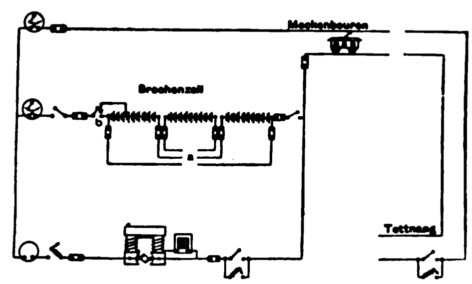


FIG. 3.

Fig. 2 shows the current and pressure curves obtained with this arrangement on the system in question, during a period of 24 minutes. The curves are self-explanatory: a b is the curve of current supplied to the trolley wire so that the shaded area is the consumption in ampere minutes. It is seen that the current varies from 20 to 210 amperes, and the six minutes' service is clearly shown by the peaks, s s, of the curve. One can also notice by the pairs of peaks, s and t, that the times of departure are not practically simultaneous at the two ends of the line. The curve, c d, represents the current generated by the machines. The mean value of this is 90 amperes, and the current only varies between 72 and 102 amperes. This maximum difference occurs only once in the 24 minutes, and during the greater part of the time the current remains between 85 and 90 amperes. The curve, e f, representing the pressure is very regular. The maximum variation is between 535 and 560, and these extreme values have only occurred once during the 24 minutes.

The above mentioned battery has been in use two and one-half years (during the last nine months of which it has been connected directly to the dynamo terminals), but it shows no trace of wear.

The author next describes the Tettnang electric railway. The demand for electric light and power supplied from the railway power station increased to such an extent that it became desirable to add to the plant, especially as the traffic on the line had also considerably increased. On the advice of Herr Oscar von Miller a battery of 318 Hagen cells was put down. This battery may be discharged for half an hour on the railway circuit, at 30 amperes, while momentary currents of 160 amperes are permissible. The full output of the machine, viz., 72 amperes, may be used as charging current. The connections are shown in Fig. 3, from which it is seen that they are on the same principle as the connections for the Zürich-Hirslanden line, shown in Fig. 1. The machine is compound-wound, but for working in parallel with accumulators the series-winding is disconnected. This machine is built for a pressure of 700 volts, and as this pressure may not be exceeded, the cells are only charged to 2.2 volts each during the day, which suffices for ordinary working. The cells must, however, be fully charged once a day, and a switch is provided at a for the purpose. The battery is divided into three groups of 106 cells; two of these are charged in series, while the other one remains switched out. At equal intervals of time the position of the three groups is changed, so that all get equally charged. The charging takes from one-quarter to one-half an hour, and it is done either before traffic on the line starts or after it has ceased.

There is a reserve steam plant at the other end of the line in case of failure of the hydraulically driven plant at the main power station at Brockenzell. The cells can also be worked in parallel with this plant, but then, as there is a drop of 50 volts in the main, 25 cells are switched out by means of the switch, b.

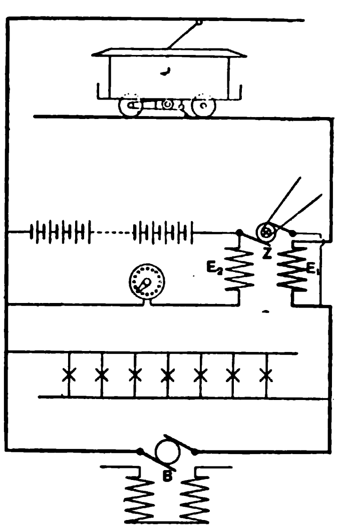


FIG. 4.

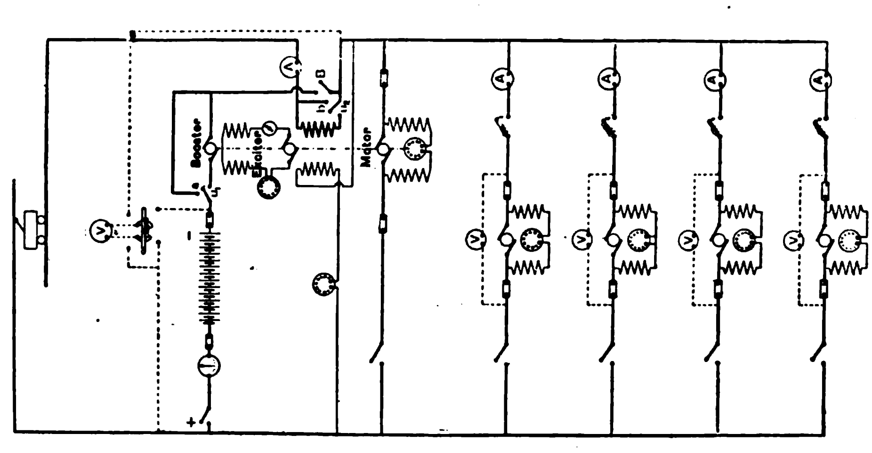


FIG. 5.

The Remscheid Electric Tramway.—The Remscheid electric line, which was built in 1892 by the Union Electricitäts Gesellschaft, has always excited considerable interest in view of the uneven nature of the ground. There is a difference in level of 350 feet, between two points on the line only 1½ miles apart, part of this section including a gradient of 10.6 per cent. There are, moreover, only 60 yards level on the whole 6.8 miles of line. To keep the pressure constant an arrangement, devised by Messrs. Siemens and Halske, was used. Fig.

[1]Abstract of a paper read before the Elektrotechnischer Verein.

4 is a diagram of the original method, and Fig. 5 the modification employed at Remscheid.

Referring to Fig. 4, the belt-driven booster, Z, has two field-windings in opposition to one another. The winding, E_2, is excited by the batteries, and the winding, E_1, is traversed by the current flowing from the dynamo. If the demand for current for the line is equal to the output of the chief generator, B, the battery must neither give nor receive current and the pressure at the terminals of Z must be zero, i. e., the currents through the two windings must neutralize one another's action. If the demand for current is less than the output of the machine, B, the effect of the winding, E_2, is the stronger, and in consequence the machine, Z, generates current in the right direction for charging the cells. If a current above the normal is required from the line, the winding, E_1, changes the polarity of the machine, Z, so that this adds to the pressure in the battery circuit, and the cells supply current to the line.

The arrangement at Remscheid only differs from this by the employment of a small additional machine, which serves as exciter for the booster, and is provided with the double field-winding instead of the booster itself. This is because of the size of the booster, which is designed to give 600 amperes at 100 volts for ten minutes. These two machines, the booster and its exciter, are driven by a direct-coupled 90 h. p. motor. In the diagram the motor is shown at the end of this combination. This has been done for clearness; actually the motor is between the exciter and the booster, which are directly coupled to it. The battery can be connected directly in parallel with the main machines if required, by switching on the switch, B, switching u_1 to a, and u_2 to b, and thus disconnecting the booster. The two latter switches are connected to one handle; they must be moved over at a moment when the current from the battery is exactly 0, so that it is best to stop the booster first.

The battery consists of 250 cells of the Hagen make, having a capacity of 648 ampere hours at a discharge rate of 216 amperes, though a current up to 420 amperes may be taken from them.

The dynamos are compound-wound, but a trial showed that they could generate 150 amperes at 500 volts without their series-windings, so they are used as ordinary shunt machines now that they are working in parallel with batteries.

At Remscheid it has been calculated that over 11 tons of coal are saved per week since the traction system was altered. But it is not only the coal consumption that must be considered, 200 h. p. of the dynamo output has been saved, and the battery that effected this saving only cost half as much as the machines which have been set at liberty, and are now available for any further increase in the load.

TELEPHONY AND TELEGRAPHY

INDEPENDENT TELEPHONY IN NEW ORLEANS.

MR. J. J. FOWLER, who was formerly with the Great Southern Telephone and Telegraph Company, is now busy organizing an independent telephone exchange, as already announced in these columns. This concern is to have a capital of $250,000 and will be known as the Louisiana Telephone, Telegraph and Construction Company. His intention is to place telephones in business houses at $50 per annum for the service and in private residences at $35 per annum. This includes the cost of the erection of the lines and maintenance of the instruments and apparatus, and these rates are to apply to all persons in the populated portions of the city. Mr. Fowler expects to place every share of the new company in New Orleans, so that the property shall be owned and operated there. He feels perfectly satisfied that the investment will yield dividends of at least 6 per cent., if not more. The $250,000 of capital stock will be amply sufficient to cover the city with the system and place the wires in the central portions of the city underground. Not one dollar is to be reserved for promoting interests, the entire capital stock being represented by stockholders, who have the privilege of selecting all the officers who will, in their judgment, best carry out their wishes, both as to the manner of investment and the results to be obtained from the permanency of construction and service. The construction of exterior lines, instruments, etc., as well as the equipment of the central exchange and all auxiliary offices are to be of the very highest standard. The service will consist entirely of metallic circuits.

Relative to placing the wires underground, Mr. Fowler says he apprehends no difficulties from the nature of the soil and other objections advanced by parties who oppose an underground system. He intends to have all the wires for a large area underground. He says this is entirely feasible by laying a system of subways, into which will be laid cables of, say, 200 wires each. Beyond this district pole lines are to be run, which, however, are to be changed into underground lines whenever the requirements, or the city authorities will so direct. In order that these pole lines should not be overloaded a system of branch offices will be established, which will be connected with the central exchange by a system of trunk lines, thus reducing to a minimum the number of wires leading from one section of the city to another.

Relative to the system of subways and cables which Mr. Fowler proposes to place underground, he said that while some contended that it was impossible to lay wires underground in New Orleans, he not only felt confident that this could be accomplished, but he had the opinion of the most expert constructing engineers in the country on the feasibility of laying underground wires here with every prospect of success. As regarded the kind of conduits which he would employ he said that he would use cypress. Its porousness would not be detrimental, and the lasting qualities of the wood underground are too well known to require repetition. Each cable is to contain 200 wires (100 subscribers), while the subways will be large enough to admit of expansion. Provision will be made for 3,000 subscribers. At every square (or where the blocks are short), every two squares, manholes will be located, which will be, say, 5½ feet deep. The present time would be most opportune for laying the underground system, as New Orleans is on the eve of making great permanent improvements in the matter of sewerage, drainage and permanent pavements, and the system will have been laid out of the way before the other improvements were commenced. The cost of maintaining the underground system would be much less (it would be as 6 to 18 or 20) in proportion, a fact which would also cut quite a figure in the charges for the service. This means a saving of $60,000 per annum to the telephone subscribers of New Orleans, and this, with the earnings of the company, would all remain there, as the citizens would own the property.

LONG DISTANCE TELEPHONY AND THE RAILROADS.

IT does not seem within the scope of the ordinary human understanding, says the Cincinnati "Enquirer," that the immense passenger traffic of a railroad of the marvelous extent of the Pennsylvania Company or any similar line could be visibly affected by the long distance telephone. Such a statement ordinarily would be received with ridicule and laughter by the common railroad officials, and treated with contempt by the higher authorities. Yet no lesser personage than James McCrea, the head of the western branches of the Pennsylvania system, told President M. E. Ingalls, of the Big Four and Chesapeake & Ohio railroads this week that the business of the famous limited train of their company had been practically ruined by this instrument. These two gentlemen met yesterday in consultation in reference to commercial relations between the two lines, and during their negotiations the subject of the falling off of the passenger traffic of the country was brought up. Various reasons were given, when Mr. McCrea made his decidedly sensational statement. It is well known that the Pennsylvania limited was originated and run in a measure for the benefit of the brokers and business men of Chicago and the Northwest, who needed quick action in the matter of travel. Their trips to New York were taken upon occasions of utmost importance, when time meant thousands of dollars. By means of the limited the broker or business man was taken to New York in the quickest possible way. There was no delay in getting there, it meant rapid business talk and equally as quick a return to Chicago. The business man was willing to pay the price assessed for the development in rapid transit displayed by the limited.

Then came the introduction of the long distance telephone. People were slow in realizing its benefit. Slowly but surely they have, however, acquired its significance. A broker in Chicago or a grain dealer in that city has an idea for a big deal; he telegraphs to New York asking for certain information: "Call me up by long distance telephone and give me your answer." The result is that for $15, perhaps $20, a talk is held with the New York man. He has had an opportunity to concentrate his expressions to the shortest possible statement; he has even jotted it down, and at the proper time calls up his

man and transacts business. So it is done every day. Mr. McCrea gave as an evidence that in the past he found it necessary to spend twenty days in the month on the road, leaving but ten days of his time at home. By aid of the long distance telephone now he has reversed matters; it requires but ten days of his time upon the road, giving him twenty days at home. The matter, when it came to the attention of an "Enquirer" representative, was presented to various business men upon the chamber of commerce and upon Third street. Half a dozen grain men, who have been in the habit of making two and three trips a week to Chicago, said: "Oh, yes, that has been the case with me; I have for $3 or $4 been able to transact business which otherwise meant a trip to Chicago or St. Louis." The same way with commission dealers and brokers. They indorsed the statements of the grain men and stated that the telephone had saved them numerous trips. The financial brokers and bankers of Third street use the telephone continually now; in fact, it is quite the feature of several of the more prominent brokers since they have their long distance telephone connections, but it has never become so prominent a factor in railway circles as has been stamped by Mr. McCrea's utterances. If it practically interferes with a great train like the limited a revolution is certainly taking place in railroad affairs.

NEWS AND NOTES

WELLMAN HOISTING MAGNETS IN THE ILLINOIS STEEL WORKS.

FROM time to time attention has been called to the desirability of employing the lifting power of magnets in various shop operations; and apparatus to that end has been devised and used both here and abroad, as noted in our columns. We now show the practical and successful type of apparatus of this class supplied by the Wellman-Seaver Engineering Company, of Cleveland, Ohio, to the Illinois Steel Company for their plate mill; and the illustrations are from the plates to be lifted the electric connection is made by means of an ordinary switch, placed in a convenient position in the operator's cage. The magnets are so designed that they are practically waterproof, and can be used for handling plates and other material out of doors. The double pole magnets in use at the Illinois Steel Company can handle with

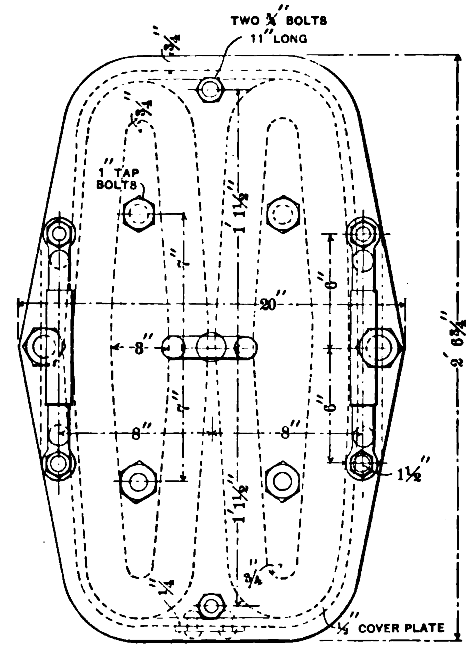


FIG. 2.

safety 5 tons, and only take about 4 amperes, with a 240 volt current.

Considerable difficulty was experienced on first starting the magnet in picking up single plates from a pile, as the magnetism was carried through several plates. The operator, however, in a very short time became expert in operating the switch. After the magnet has been lowered on to a pile of

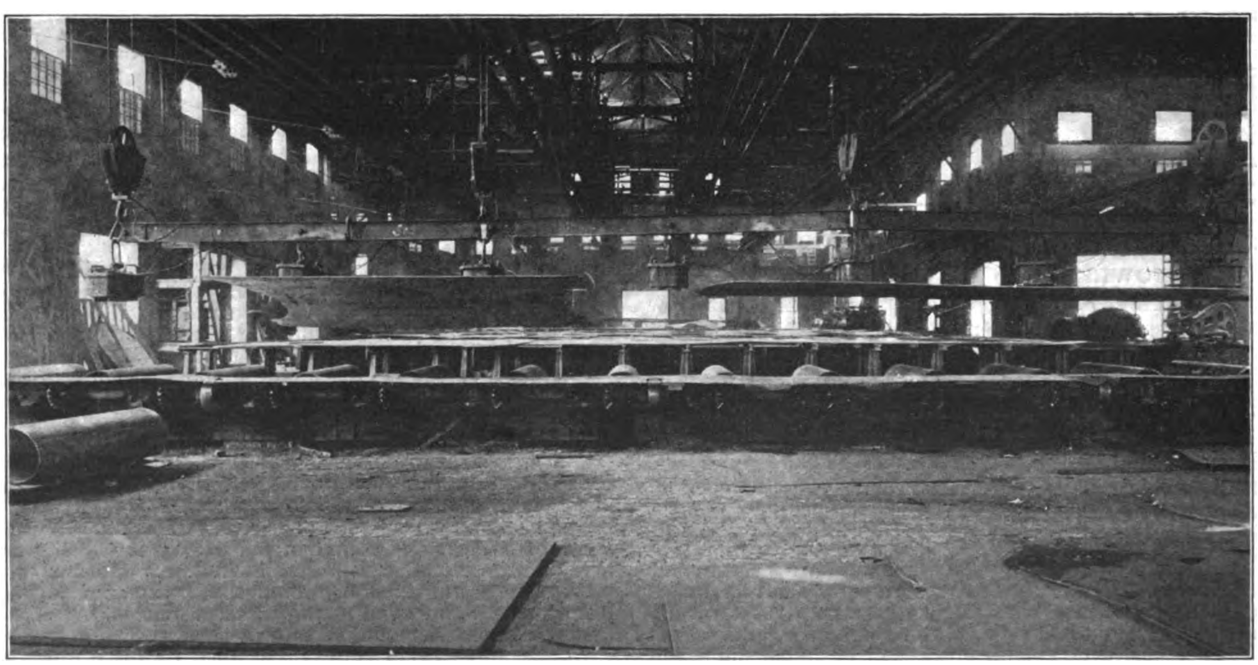


FIG. 1.—WELLMAN HOISTING MAGNETS IN ILLINOIS STEEL CO.'S PLATE MILL.

the "Iron Age." Magnets for this work in connection with an electric traveling crane are specially well adapted for handling plates, as the connections to the magnet are placed on the bridge of the crane in the same manner as the connections for the operating motors, and after the magnet is placed on plates and several plates have been taken up together, the operator simply pulls the switch out, thereby breaking the current for an instant. By this operation one or two plates can be dropped off at each breaking of the current, residual magnetism enough remaining in the plates next to the mag-

net to hold them until the current is again switched on. This operation is continued until only one plate remains attached. The concentric pole magnet, Fig. 4, was specially designed for handling hot plates and ingots, and there has been no difficulty in handling a 6,000 or 8,000-pound ingot at a low red heat.

The use of electric magnets has been very limited. But

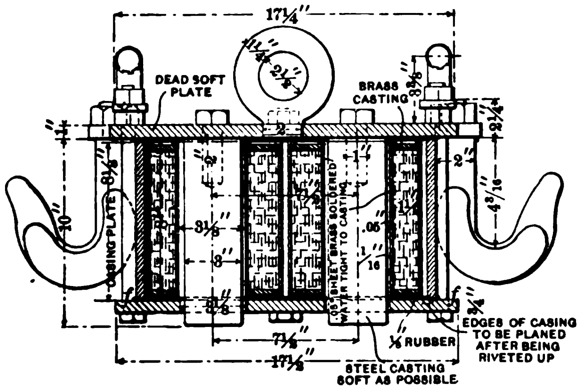


FIG. 3.

where the iron or steel to be handled is in such shape that it is possible to get a good contact, there is no doubt but that it is the most economical and rapid method of handling. A great many concerns have been afraid to put magnets into use on account of the apparent danger of dropping the material and thus endangering the men who may be at work. In the years of experience the Wellman-Seaver Company have had they do not know of a single case where any one has been injured by the material dropping, and they firmly believe it is the safest way possible to handle certain classes of

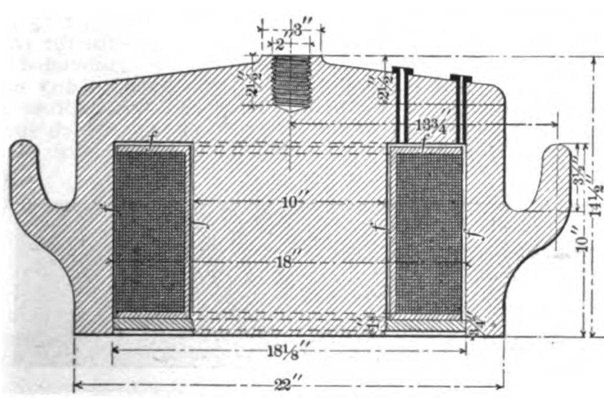


FIG. 4.

iron and steel product. The magnets are so designed that it is impossible for the men that are placing the magnets to receive a shock. It may be noted that in using magnets of this type at the Otis Works in 1889 to load billets from a stock-yard pile on to cars, it was found that the billets were too entangled in the heap to pull out with sufficient freedom.

PROF. SHORT'S DEVICE TO SECURE LOW RELUCTANCE.

AN interesting patent, No. 588,491, has just been issued to Prof. S. H. Short on his invention which has the object of furnishing a multipolar dynamo, motor or rotary transformer in which there are combined two advantages hitherto regarded as rather incompatible, namely, a very low reluctance or magnetic resistance and an absence of the hitherto consequent counter-currents in the armature, which cause bucking when the machine is started. Prof. Short has discovered that if he surrounds the magnetic circuit at various points in its length, outside the armature, with metallic bands or other closed conductors of very low electrical resistance, serious troubles are overcome and the desired result is attained. His drawing and patent specification illustrate and describe bands preferably of copper placed along the field yoke between the field magnet cores. They can be first formed and placed in the mold for the yoke, so that when the yoke is cast the surface will be flush. The principle involved is that an induced current results in a band in one direction when the magnetic flux is increased, and in the opposite direction when it is decreased. This induced current reacts upon the magnet core and reduces or increases the flux. The fluctuations of the magnetic flux and the consequent evils are therefore practically stopped. The same reasoning applies on similar lines to a motor or a rotary transformer.

THE BREAKDOWN OF THE COAL BINS IN THE EDISON STATION AT PATERSON, N. J.

A SINGULAR accident at the fine station of the Edison Electric Illuminating Company, of Paterson, N. J., last week deprived a large number of customers of light and power and suspended the operation of a good many miles of trolley lines which drew current from that source. It will be remembered that the station in question was described and

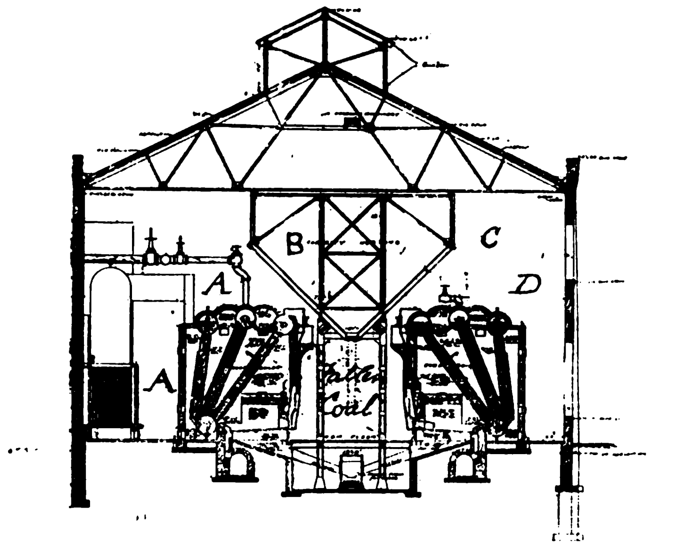


FIG. 1.—DIAGRAM, PATERSON, N. J., EDISON STATION BOILER ROOM.

profusely illustrated in The Electrical Engineer, of December 9, 1896. The accident was the sudden breakdown of the coal pockets in the building, over the boiler room, large quantities of coal thus literally swamping the boiler room. Fig. 1 shows the scene by diagram. Fig. 2 is from a photograph taken about forty-five hours after the accident, when the major portion of the coal and debris had been cleared out of the way.

The bin was designed and constructed about eighteen

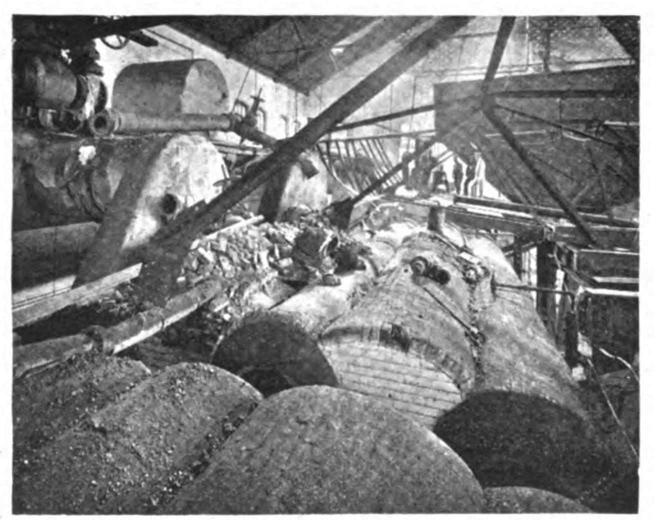


FIG. 2.—A VIEW OF THE COAL BINS AFTER THE ACCIDENT, PATERSON, N. J.

months ago. The space on the right, Fig. 1, is vacant, no boilers having as yet been placed on that side. At the time of the accident (which occurred at 4:30 p. m. on the 14th inst.) the bin contained approximately 1,000 tons of coal. The bin burst near the center on the right, at D, the moving mass of coal ripping off the entire side. The trussed ties thus losing their support, the left side of the bin with its contents of several hundred tons of coal toppled over on the boilers, carrying with it every foot of the 12-inch steam mains and every

boiler connection. The coal banked up against the boiler front 10 feet high, nearly filling the space, A, between the economizers and boilers and covering the feed-pumps. Probably 200 tons of coal remained in the wreckage on the boilers and bottom of bin. One hundred and fifty men in relays were immediately set to work shoveling coal which had to be moved practically three or four times. A force of men from the Passaic Rolling Mills, Paterson, and from Milliken Bros., New York, were promptly at work taking down the wreckage, while four sets of steamfitters were at work taking down pipe here, an elbow there, removing good flanges from broken pipe, the whole going to make up a complete connection for one boiler. Within twenty-eight hours from the hour of the collapse, General Manager W. M. Brock, had No. 1 boiler of the battery of six under steam and by midnight the city arc lamps and incandescent system were in service, and the street railways started on schedule time Monday morning.

By building a temporary 8-inch main from No. 1 boiler to No. 6, they were able to place the latter in service by 9 p. m. on the 16th. It might be interesting to note that during the greater part of Monday boiler No. 1 developed continuously from 1,400 to 1,700 h. p. at 150 pounds pressure under forced draught. It is doubted whether hotter fires were ever seen under a boiler. Based on the engine duty of about 18 pounds, the boiler would have a nominal capacity of about 830 h. p. The iron plating of the bin was pierced by every safety valve of five of the boilers.

LORD KELVIN AND THE NIAGARA POWER TRANSMISSION.

BY ORRIN E. DUNLAP.

LORD KELVIN, past president of the British Association for the Advancement of Science, has been to Niagara Falls, and in company with Dr. Coleman Sellers has looked upon the big turbines and generators. It will be recalled that Lord Kelvin, then Sir William Thomson, was president of the International Niagara Commission established in London, England, in June, 1890, for the purpose of examining plans for the then proposed Niagara development, and that the Niagara Falls Power Company acted upon the suggestions of the commission. Despite Lord Kelvin's prominent connection with the project in its early stages, he had never until Sunday, August 14, looked upon the results of the development other than in pictures. For this reason, if for no other, this initial visit of the noted scientist and electrician to the great power plant at Niagara was replete with interest. Dr. Sellers, who also was a member of the International Niagara Commission, and who is now president of the Niagara Falls Power Company, was at the Cataract House to be among the first to greet Lord Kelvin on his arrival at the Falls from New York. The greeting of the two great men was full of feeling. When they last met it was on Lord Kelvin's native shores, and now Dr. Sellers was the host representing his company at the request of President Adams, of the Cataract Construction Company, to extend courtesies to the members of the British Association.

Over two decades of years had passed since Lord Kelvin was at the Falls before, and what changes those years had wrought! The year was 1876. The idea of using the waters of the Niagara was in many minds. Much had been written upon it. Several comparatively small factories were using power from the hydraulic canal, but the total amount of power so used was very small. The above facts were recited by Lord Kelvin by way of introduction to the interview, and then he was asked: "You were originally inclined to believe that power could be transmitted much more economically by some new appliance rather than by shafting?"

"Yes. At the fiftieth annual meeting of the British Association in York, I gave estimates of appliances by which power could be transmitted from Niagara Falls to a distance of 300 miles by a single wire, but instead of a single wire 300 miles long, the calculation would be applied to transmit 150 miles by wire and return, insulated metallic circuit, and I showed that it was only a question of the voltage used what would be the loss of energy in the wire. I gave an estimate on transmission with 20,000 volts, and I think about 20 per cent. would be lost on the way. A voltage of 30,000 would be possible, but neither then nor now would I advise the adoption of so high a voltage as that. There would be no difficulty in using 20,000 volts for transmission to a distance of 20 miles, and a fairly economical transmission to a distance of 40 miles. Forty miles could be realized, but most probably it would be much better for the factories to come to the power, or to come within 10 miles of the power, than to transmit to a great distance."

"You think the future of Niagara Falls is more assured by this power development than by anything else?"

"Yes. I think we already see the beginning of what is destined to grow into a great industrial district around Niagara Falls, within ten or twenty miles of Niagara, both on the United States side and on the Canadian side. I do not prophecy anything, but I anticipate industry will advance on both sides of the border, and that the power of Niagara will be taken advantage of to any extent we may imagine. I have witnessed with great interest the advancement made by the Cataract Construction Company with the project of using 120,000 h. p., and the actual realization of a large part of the project. Also the prospect in the near future of 50,000 h. p. being actually generated by ten turbines and transmitted to distances from five to twenty miles—it may be further—and to shorter distances."

"These units of power are what you recommended to the International Niagara Commission? It was decided by the commission that 5,000 h. p. would be a possible amount of power to be transmitted?"

"I was chairman of the commission invited by the Cataract Construction Company to meet in London and consider the project. That commission decided, or concluded, that a 5,000 h. p. unit for development of the power by a single turbine was practicable, although the greatest amount of horse-power given by a single turbine before that was only 1,500 h. p. From this it will be seen that the Cataract Construction Company and the Commission had the courage to make a great step in advance of anything that had been done before. Still this was only looking into the future, and the commission left the development to the Cataract Construction Company after considering plans that had been given them by many of the greatest constructors of turbines and of electrical machinery. After carefully considering what could be done either by electricity or compressed air or by hydraulic pressure for transmitting power, the Commission strongly recommended the choice of electrical transmission in preference to any other known or conceivable method. They did not express any opinion as to the nature of the electrical current which should be used, as they believed at that time that the state of the art was one of transition. It might be in the future turned one way or the other, and no one could project exactly what could be developed.

LORD KELVIN'S AUTOGRAPH IN NIAGARA POWER REGISTER.

"Very much pleased to see the great success here achieved as the result of courageous undertaking and originality of invention and skillful design and construction. K."

"The Cataract Construction Company have carried out the project left in their hands, and have taken advantage of great developments in electrical engineering, which have grown up since the sittings of the commission. In the result as we now have it in the power house of the Niagara Falls Power Company, and in the several factories, chiefly at present electro-chemical, which have sprung up around it within the last four years; in the electric supply of the tramways between Niagara Falls and Buffalo on the one side and Lewiston on the other, and in the local lighting of Niagara Falls, we already have a splendid installment of the work projected and now in progress for utilizing the great natural power of the place.

"Positively, I have been intensely interested in all that I have seen here during the last three days, and I can scarcely find words adequate to express the great admiration which I feel for the inventiveness, the scientific care in design and the skill in execution which I have witnessed in the power house, and in some of the factories supplied by it. These results and the smooth and uninterrupted success in the actual working during the two years which have passed since the first of the dynamos commenced running, in August, 1895, are largely due to the hearty and harmonious co-operation of the great electrical construction companies and their generous

rivalry in assisting the scientific staffs of the Cataract Construction Company and the Niagara Falls Power Company."

"The originators of the work so far carried out and now in progress hold concessions for the development of 450,000 h. p. from the Niagara River. I do not myself believe any such limit will bind the use of this great natural gift and I look forward to the time when the whole water from Lake Erie will find its way to the lower level of Lake Ontario through machinery doing more good for the world than that great benefit which we now possess in the contemplation of the splendid scene which we have presented before us at the present time by the waterfall of Niagara. I wish I could think it possible that I could live to see this grand development."

A well known gentleman who was present and heard Lord Kelvin's words stated that it might be well for him to insert a saving clause in that statement, the gentleman having in mind the past unnecessary alarm about the beauty of the falls being impaired by power development, but Lord Kelvin warmed up as at no previous time in the interview and said:

"No. I do not hope that our children's children will ever see the Niagara cataract."

His enthusiasm over what he had seen while in the great power house was no doubt finding its way to expression, and these few words well portray how he enjoyed his visit at the Falls.

"I may add," continued he, "if it is not irrelevant to the questions you have put to me, that I look forward to a revival of both life and prosperity in the Highlands of Scotland, the present crofters being succeeded by a happy, industrial population, occupied largely in manufactories, to be rendered possible by the utilization of all the water-power of the country. The people there say that to do away with the Falls of Foyers is to replace the porters and guides of tourists by an industrious people. It seems to me a happy thought that the poor people of the country will be industrious artisans, rather than mere guides and assistants to tourists."

"Am I to understand that it is your belief that the limit of power transmission with present day apparatus is twenty miles?"

"Forty miles. Rather let the factories come to the power than the power go to the factory."

"How about lighting New York City by Niagara electricity?"

"Of course, with electric lighting that is another question. You cannot bring New York to the Falls to be lighted, but you can bring factories to the Falls to be operated."

"Do you think it possible, then, to light New York from Niagara?"

"It would be too expensive. It could be done, but more than half of the current would be lost in transmission."

"Will electrical apparatus, in your opinion, undergo great changes?"

"No doubt there will be great improvements. There has been enormous improvement during the last five years, and it is not unlikely that the next five will be less progressive than the last."

"In your opinion, what is most needed in the electrical science to-day?"

"More and more of it."

This ended the interview, and Lord Kelvin and party departed with William B. Rankine, secretary of the Cataract Construction Company, for a trip over the great gorge road and the Canadian Park road, where he had another opportunity to see what electricity is doing for the Niagara locality.

Mr. W. B. Rankine. Lady Kelvin. Dr. Coleman Sellers. Lord Kelvin. Dr. J. F. Bottomley. Mrs. Bottomley.

LORD KELVIN AND PARTY AT NIAGARA.

LETTERS TO THE EDITOR

LAMP RESISTANCES FOR ARCS IN MULTIPLE.

I note in your issue of the 19th of August an article headed: "Wasted Current in Arc Lamps," with the suggestion as to the substitution of an incandescent lamp for the dead resistance.

I beg to herewith hand you a price list of series incandescent lamps, by which you will see we have for some time past been making just such a lamp.

CONVERSE D. MARSH,
President Bryan-Marsh Company.

New York City, Aug. 20, 1897.

SOCIETY & CLUB NOTES

THE NINETEENTH ANNUAL CLAMBAKE OF THE AMERICAN ELECTRICAL WORKS.

THE nineteenth annual clambake given by Mr. Eugene Phillips, as president of the American Electrical Works, Providence, R. I., to the electrical fraternity took place on Saturday, August 21, at the Pomham Club, near that city. There were 292 guests present, many from distant cities, showing the high esteem in which Mr. Phillips is held and the popularity of his clambake. After a pleasant half-hour's trolley ride from Providence the invited guests found themselves at the club, which is most delightfully situated on the Providence River. Lunch was served from 11:30 until 2 p. m., during which time the guests enjoyed themselves with all sorts of in and outdoor pleasures. Immediately before the clam dinner all of the guests arranged themselves in a group and were photographed. At about 2 o'clock p. m. the clam dinner, a decidedly elaborate affair, was served in the spacious hall of the club house. Every one present was by this time in a very jovial mood, and the speeches made were certainly an index to the happy frame of mind all were in. Mr. Phillips, speaking first, greeted his guests in a most cordial manner, and stated he was "heartily glad to see each and every one," and further on commented upon the enormous strides made in the electrical field. Mr. Samuel Powers, of the New England Telephone Company, was called upon to act as toastmaster of the occasion. Representing the "telegraph interests," Mr. Samuel A. Duncan, of the Postal Telegraph Company, was thereupon requested to make a speech. Mr. Duncan responded in a humorous way, connecting the Phillips family, and Mr. Eugene Phillips in particular, with the Morse system of telegraph. Mr. H. F. Wood, of the West End Street Railway of Boston, dwelt upon the many miles of electric railways built in this country and the cheapness of transportation. Responding to the toast of "Electrical Journalism," Mr. Robert F. Ross made a neat speech. His Honor Mayor McGinnis, of Providence, then spoke regarding the many large manufacturers in that city and the successful establishment of which Mr. Phillips is the president. In behalf of the Electric Light Association, Vice-President Stetson responded in a decidedly humorous vein. In like manner Mr. Stetson was followed by Capt. John C. White, who spoke in high praise of Mr. Phillips and commented at length on his enterprise and generosity. The after-dinner speeches closed with remarks again by Mr. Samuel Powers, the toast-master, thanking Mr. Phillips, and the bake ended with many cheers by the assembled guests. The day was an ideal one for the event, and will certainly be remembered by all who were present. Handsome souvenir canes were distributed.

OFFICERS OF THE AM. ASSOC. AD. SCI.

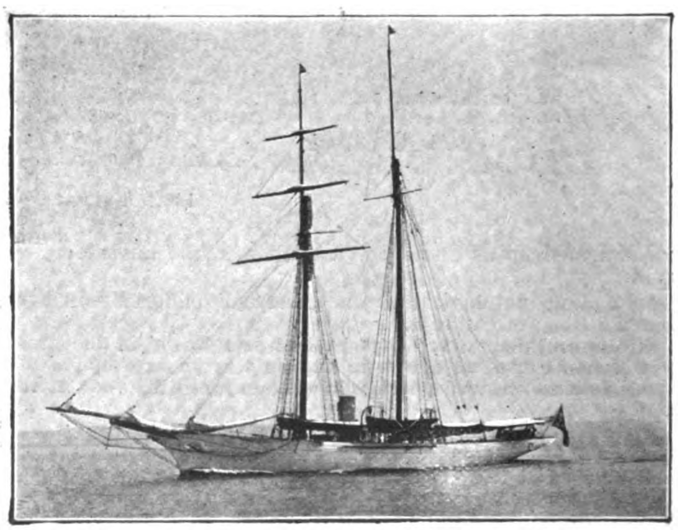
The new officers of the American Association for the Advancement of Science are the following: President, F. W. Putnam, Cambridge, Mass.; permanent secretary, L. O. Howard, Washington, D. C.; general secretary, D. S. Kellicott, Columbus, O.; council secretary, F. Bedell, Ithaca, N. Y.; treasurer, R. S. Woodward, New York; vice-presidents, mathematics and astronomy, E. E. Barnard, University of Chicago; physics, Frank P. Whitman, Adelbert College, Cleveland; chemistry, Edgar F. Smith, University of Pennsylvania; mechanical science and engineering, M. E. Cooley, University of Michigan; economic science and statistics, Archibald Blue, director of Bureau of Mines, Toronto, Canada; secretaries of the sections, mathematics and astronomy, Alexander Ziwet, University of Michigan; physics, E. B. Ross, Wesleyan University; chemistry, Charles Baskerville, University of North Carolina; mechanical science and engineering, William S. Aldrich, University of West Virginia; economic science and statistics, Marcus Benjamin, United States National Museum, Washington, D. C.

TORONTO MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE Toronto meeting of the British Association began last week at the University Building, Toronto, and continues during the present week until Wednesday. The attendance is very good, the number registering being not less than 1,500, inclusive of a great many Americans. The regular work of the Association appears to be fully up to the record, and has been accompanied by several social entertainments and functions of a delightful character. Last Saturday was an exceedingly busy day at the power house of the Niagara Falls Power Company, at Niagara Falls, the occasion being the visit of the members of the British Association, who went over from Toronto, Ont., to see the installation. It was about 11 a. m. when the first of the delegation arrived, and they were rapidly followed by others. When the members and their friends reached the power house, they were met by Dr. Sellers, president of the Niagara Falls Power Company, W. B. Rankine, secretary of the Cataract Construction Company, Resident Engineer W. A. Brackenridge, Superintendent Lincoln, Mr. W. K. Dunlap and others connected with the plant, and were escorted about the interior of the building, every part being most carefully explained by the always courteous officials. The generators, the governors, the switchboard and other parts of the installation all came in for careful inspection, after which the party boarded a train and were carried over the Junction Railway and to some of the plants thrown open to their inspection. All were intensely enthusiastic over what they saw, and some took occasion to inscribe in the autograph book of the company their appreciation of the attention Dr. Sellers had shown them. Some of the visitors on leaving the power house turned their attention to scenic Niagara and hurried away to the beautiful State reservation. Many of the party remained at the Falls over Sunday, returning to Toronto Monday morning. Abstracts of the more interesting papers will appear in our columns next week.

THE SAFETY CO.'S EXCURSION ON THE HILDEGARDE.

A NOVEL and very delightful excursion was given last Wednesday, August 18, by the Safety Insulated Wire and Cable Company to a large number of their electrical friends, on board the fine auxiliary steam yacht "Hildegarde," formerly the property of the Prince of Wales, and placed at the disposal of the company by its president, Mr. B. M. Whitlock, rear commodore of the Atlantic Yacht Club. The party went down to the waters off Sandy Hook, where all conveniences were handy for fishing, and the net results of the efforts of the whole party were 50 blue fish, some flounders and a few sharks. For the general amusement, music was given by the Neapolitan Mandolin Quartette, by colored minstrels and by a humorist. Refreshments were provided with lavish hand, and the comfort of the guests was assiduously looked after by Mr. Whitlock, General Manager L. F. Requa, and the staff of



THE AUXILIARY STEAM YACHT "HILDEGARDE."

the Safety Company. Hearty resolutions of congratulation and thanks were presented to the graceful entertainers for a charming day, before the party left Sandy Hook, and on the return of the yacht, further hospitality was extended in the shape of dinner at the Atlantic Yacht Club House. The "Safety" brand of excursion was voted an immense success. It should be added that the invitations were most artistic and will certainly be preserved by all as souvenirs.

MASS. STATE CONVENTION N. A. S. E.

The second State Convention of the National Association of Stationary Engineers was held at Engineers' Hall, Boston, Mass., on August 6, when a large amount of routine and other business was disposed of. The secretary's report showed a large and flattering growth. In the evening a complimentary dinner was given to the delegates at the Castle Square Hotel. The following day a trip was made down the bay to the drainage stations and Deer Island. Other excursions also took place. The attendance was very good. The press was represented by Messrs. F. R. Lowe, editor of "Power"; J. O. Sullivan, Boston "Globe," and A. J. Guernsey, The Electrical Engineer. The president of the association is Mr. P. H. Hogan, the engineer of the Institute of Technology.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

The fifth annual meeting of the Society was held last week at Toronto, in connection with the meeting of the British Association. The president, Dr. H. T. Eddy, was in the chair, and papers were presented on methods of teaching, by Prof. W. H. P. Creighton; calculus for engineering students, by Prof. F. W. McNair; teaching of machine design, by Prof. J. J. Flather; chemical technology, by Prof. H. Bunte, of Germany; chemical engineering, by Dr. J. M. Ordway; technical versus literary training, by Prof. T. C. Mendenhall; French and German for engineers, by Prof. A. N. Van Daell; electrical engineering study, by Prof. R. B. Owens, and helping students in specific research, by Prof. C. D. Marx. The paper by Prof. Owens is given in this issue.

THE STOCK MARKET

CHEERFUL NEWS.

THE most noteworthy feature in current affairs has been the great rise in the price of American wheat, which has already crossed the dollar mark, and at this writing is well on its way to another quarter.

In view of this fact, more than in regard to any other condition, the volume of general trade is growing and prices are hardening. Bank clearings are 40 per cent. heavier than in the corresponding week of last year, and railroad earnings are steadily improving. The number of business failures last week was 214, or half of what it was in the same week of the panic year, 1893. Silver has definitely parted company with wheat, and the two prices are shown absolutely to have no relationship. Silver to-day is lower than ever, being only 52 cents for commercial bar, per ounce.

Quotations on the New York stock market have been steady since the last great rise a week ago. Of Western Union, 28,-545 shares were sold, closing at 91¾. General Electric sold around 36½, on 9,940 shares. American Bell telephone is steady, at 237, on sales of a few score shares. New York Metropolitan Traction new 5s. are firm around 113. New York Edison is steady at 123½, and Chicago Edison is about the same figure.

COPPER is firm around 11¼ cents for Lake ingot, 10⅞ to 11⅛ for electrolytic and 10⅝ for ordinary casting stock. Statistics show a falling off in production of not less than 3,000 tons below the average for the first half of the year.

STEEL RAILS are quoted at $21 and upward for light sections. Heavy rail mills are said to be behind their orders. Bessemer pig iron is 25 cents higher.

EDISON COMPANY, New York City, show a gain in July of $1,763 net for the month and $88,945 for the seven months, being a very substantial increase over 1896.

INVENTORS' RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 10, 1897.

Alarms and Signals:—

SIGNAL RECEIVING APPARATUS. W. F. Banks, Milford, Conn., 587,693. Filed October 1, 1896.
A two-part apparatus, the first part being arranged to respond to all impulses, and the second to only special impulses.

SWITCH BOX. Jas. C. Mock, Wilkinsburg, Pa., 587,746. Filed June 10, 1896.
Employed for making and breaking the track-circuits in accordance with the position of the switch-rails.

BURGLAR ALARM. C. Coleman, Chicago, Ill., 587,931. Filed January 11, 1897.
An electrical barrier consisting of overlapping parallel insulating-strips and parallel conducting-strips secured to the insulating-strips.

ELECTRO-PNEUMATIC ALARM. Geo. W. MacKenzie, Beaver, Pa., 587,998. Filed April 15, 1897.
Designed to operate by atmospheric disturbance.

ELECTRIC ALARM. R. Penney, National Military Home, O., 588,-004. Filed January 2, 1897.
Adapted to produce a loud musical sound, for use on street cars.

Batteries, Secondary:—

PROCESS OF TREATING ALLOYS FOR MANUFACTURING ELECTRODES. L. P. Hulin, Modane, France, 587,829. Filed December 21, 1894.
Consists in alloying a heavy metal with barium, and treating the alloy with a liquid to eliminate the barium and produce a spongy-metal electrode.

Conductors, Conduits and Insulators:—

INSULATOR FOR WIRES. Geo. Ashby, Hamilton, Can., 588,048. Filed December 24, 1896.
Consists of a stem provided with an arm having a lug, a bolt connected with the stem and a cylindrical piece mounted upon the bolt.

Dynamos and Motors:—

WIRE FOR ARMATURE-WINDINGS. S. H. Short, Cleveland, O., 587,764. Filed March 19, 1896.
Composed of more than two wires twisted together and having plane surfaces in contact at every point.

ARMATURE FOR DYNAMO-ELECTRIC MACHINES. S. H. Short, Cleveland, O., 587,765. Filed March 29, 1897.
Embodies a laminated core, the inner edges of the laminations being straight, and adjacent layers being lap-jointed.

ELECTRIC MOTOR. Julius L. Thoma, Kansas City, Mo., 587,769. Filed August 17, 1896.
Embodies duplicate armatures one above and the other below the poles of the field-coils.

COMMUTATOR AND LEAD. S. H. Short, Cleveland, O., 587,868. Filed March 12, 1897.
Method of insulating the commutator-bars and their leads.

FIELD-MAGNET FOR DYNAMO-ELECTRIC MACHINES. S. H. Short, Cleveland, O., 587,869. Filed March 12, 1897.
Composed of solid magnet-cores, each having one end furcated by intersecting slots, combined with a yoke cast about the furcated ends of the magnet-cores.

ARMATURE. S. H. Short, Cleveland, O., 587,871. Filed March 13, 1897.
Comprises a slotted core, and an end ring at each end of the core having peripheries adapted to support the armature-inductors beyond the core.

APPARATUS FOR GENERATING CONSTANT ELECTRIC CURRENTS. Chas. N. Black, New Haven, Conn., 587,921. Filed April 26, 1897.
Comprises a multi-circuit constant current dynamo, a steam engine having a fixed point of cut-off and an automatic steam cut-off.

Electro-Metallurgy:—

ELECTROLYTIC APPARATUS. Wm. Thum, Newark, N. J., 588,-035. Filed October 8, 1896.
Adapted for the deposition of metals in a crystalline form.

PROCESS OF TREATING SULFID ORE. B. Mohr, London, Eng., 588,076. Filed June 14, 1897.
The pulverized ore is treated with acid sodium so as to obtain a solution of sulfate of zinc depositing the zinc by electrolysis, recovering the acid alkali sulfate, and treating the insoluble residue obtained by the lixiviation for recovery of the other metals.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. J. McLaughlin, Chicago, Ill., 587,750. Filed August 26, 1895.
Feed mechanism.

Measurement:

ELECTRIC METER. Jean F. De Bauw, Brussels, Belgium, 587,-798. Filed April 26, 1897.
Solenoid instrument. Details of construction.

Miscellaneous:—

APPARATUS FOR ELECTROLYSIS. A. E. W. Boucher, Prilly, Switzerland, 587,696. Filed August 13, 1896.
Consists in the use of an electrode having combined in one structure a positive and negative element insulated from one another.

APPARATUS FOR DETECTING ELECTROLYSIS OF UNDERGROUND PIPES AND LOCATING TRANSMISSION LOSSES. H. T. Brown, New York, N. Y., 587,698. Filed January 27, 1896.
Details of method.

APPARATUS FOR CAUSING CHEMICAL CHANGES IN GASES. N. Vander Sleen and A. Schneller, Alfenoudshoorn, Netherlands, 587,770. Filed January 18, 1895.
Details of construction.

ELECTRO-DEPOSITING DEVICE. John Bossard, Dubuque, Ia., 587,782. Filed June 1, 1896.

Employs a screw threaded shaft above the tank upon which the holders rest and are advanced by its rotation.

PROCESS OF AND APPARATUS FOR MANUFACTURING METALLIC PEROXIDS AND CAUSTIC ALKALIES. L. P. Hulin, Modane, France, 587,830. Filed December 26, 1894.

Details of process.

DEVICE FOR EXAMINING JEWELS BY ROENTGEN RAYS. Elihu Thomson, Swampscott, Mass., 587,883. Filed September 4, 1896.

Consists of a source of Röntgen rays, a support for the jewel, a fluorescent screen beneath the support, a mirror at an angle beneath the screen, and adjustable eye-pieces for observing the reflected image in the mirror.

PROCESS OF AND APPARATUS FOR MAKING METALLIC CARBIDS. I. L. Roberts, Brooklyn, N. Y., 588,012. Filed Sept. 14, 1896.

Consists in moving beneath a horizontal electric arc the metallic compound and carbon to be converted, and in reflecting the heat of the arc downward.

PROCESS OF AND APPARATUS FOR ELECTROCHEMICAL TREATMENT OF STRAW OR OTHER FIBROUS MATERIALS. G. H. Pond, Ashburnham, Mass., 588,084. Filed Sept. 15, 1896.

The straw is treated by the electrochemical decomposition of a solution of chlorid of sodium.

METHOD AND APPARATUS FOR ELECTROCHEMICAL TREATMENT OF FIBROUS MATERIAL. G. H. Pond, Ashburnham, Mass., 588,085. Filed Feb. 12, 1897.

Similar to above.

ELECTRICALLY-OPERATED LOOM. E. D. Chaplin, Cambridge, and H. G. Talloran, Boston, Mass., 588,101. Filed July 16, 1896.

Details of construction.

THERAPEUTIC APPARATUS. H. Sanche, Detroit, Mich., 588,-091. Filed July 7, 1892.

Consists of a connecting filament of porous material with absorbent terminals.

IGNITER FOR EXPLOSIVE ENGINES. Philip Murller, Decatur, Ill., 587,747. Filed Dec. 18, 1896.

Details of construction.

Railways and Appliances:—

ELECTRIC RAILWAY SYSTEM. S. D. Field, Stockbridge, Mass., 587,720. Filed Nov. 21, 1891.

Employs a conductor of flexible magnetic metal suspended on insulators within a slotted conduit.

ELECTRIC CONTROLLER. S. Harris, Johnstown, Pa., 587,733. Filed Jan. 7, 1897.

Comprises a rotable drum carrying contacts, and a coil surrounding a part of the drum and electrically connected to any suitable part of the circuit.

TROLLEY WIRE HANGER AND SPLICER. C. K. King, Mansfield, O., 587,740. Filed April 13, 1897.

Comprises a flanged hanger having a slot to receive the trolley wire in which it is retained by rivets.

ELECTRIC RAILWAY. R. L. Caldwell, Cleveland, O., 587,792. Filed Jan. 21, 1897.

Device to insure the trolley wheel taking the proper conductor at a switch.

TROLLEY HANGER. Theo. Fletcher, St. Louis, Mo., 587,805. Filed Oct. 10, 1896.

Comprises a longitudinal flexible strand adapted to be secured to a trolley wire and means for suspending the hanger by the flexible strand.

TROLLEY. S. H. Short, Cleveland, O., 587,870. Filed Feb. 16, 1897.

Comprises a long flangeless roller which is mounted in the forked upper end of the trolley arm.

OVERHEAD TROLLEY SYSTEM FOR ELECTRIC RAILWAYS. S. H. Cauffiel, Johnstown, Pa., 588,053. Filed July 24, 1896.

A structure for cross lines of wire.

ELECTRIC RAILWAY SYSTEM. L. E. Walkins, Springfield, Mass., 588,097. Filed April 15, 1897.

Third-rail system for long roads.

ELECTRIC LOCOMOTIVE. R. Eickemeyer, Yonkers, N. Y., R. Eickemeyer, Jr., executor of said R. Eickemeyer, deceased, 588,-104. Filed May 9, 1892.

Relates to a braking system.

CURRENT-COLLECTING DEVICE FOR ELECTRIC RAILWAYS. R. M. Hunter, Philadelphia, Pa., 588,111. Filed Feb. 4, 1897.

Comprises an insulated undermining and guiding device, and a contact device to collect the current.

ELECTRIC RAILWAY SWITCH. M. J. M. O'Hara, Wilmington, Mass., 587,752. Filed March 27, 1897.

Operated by electromagnets energized by current supplied through the trolley.

ELECTRIC LOCOMOTIVE. Rudolph Eickemeyer, Yonkers, N. Y., Rudolph Eickemeyer, Jr., executor, 588,105. Filed Aug. 23, 1892.

Method of suspending motor to the car.

Regulation:—

AUTOMATIC ELECTRICAL REGULATING DEVICE. E. W. G. C. Hoffman, Charlottenburg, and J. H. F. Görges, Berlin, Germany, 587,822. Filed April 17, 1896.

Employs a clutch to operate a contact controlling the resistance in the dynamo field circuit.

REGULATING ELECTRIC MOTORS. A. G. Davis, Washington, D. C., 587,937. Filed Nov. 17, 1896.

A method of increasing the torque of a tandem motor system, consisting in neutralizing by a phase-advancing device, part of the lag of the intermediate circuits.

MEANS FOR CONTROLLING ELECTRIC MOTORS. S. H. Short, Cleveland, O., 588,021. Filed May 7, 1896.

Means whereby a variable counter electromotive force in the motor circuit can be generated and utilized to regulate the amount of current flowing to the motor.

Switches, Cut-Outs, Etc.

LIGHTNING-ARRESTER. Edw. M. Hewlett, Schenectady, N. Y., 587,816. Filed March 16, 1897.

Of the magnetic blow-out type.

CIRCUIT-BREAKER. H. Lemp, Lynn, Mass., 587,838. Filed April 3, 1897.

A contact device for induction coils, comprising a pair of fixed terminals with a bridge consisting of a rotatable disc nominally closing the circuit.

Telegraphs:—

PRINTING-TELEGRAPH. E. M. D. Andre, Méru, France, 588,046. Filed Oct. 1, 1896.

Apparatus capable of being used either as a transmitter or as a receiver.

Telephones:—

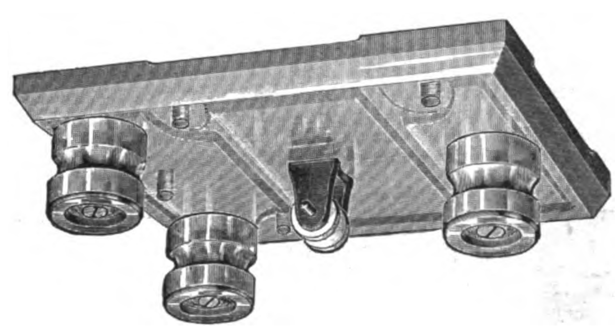
TELEPHONE-BOOTH. E. B. Cadwell, Jamestown, N. Y., 587,700. Filed Oct. 22, 1896.

Constructed with double walls distanced by wooden blocks and interposed sound deadening material between the blocks and the walls.

TRADE NOTES & NOVELTIES

THE McDONALD GLASS HANGER BOARD.

THE insulation of appliances used in high tension series arc lighting is always of the greatest importance, and particularly for inside arc light wiring where a dangerous voltage is carried into the building and directly to the lamp. A large number of arc light hanger boards have been designed from time to time, having for their object better insulation, and, for a newcomer, the McDonald glass hanger, are now claimed the most striking results. As shown in the accompanying illustration, the hanger board consists of glass insulating knobs mounted on a glass base or support. This secures a perfect insulation, which will always remain the same, as moisture or corrosion is not possible. This hanger makes a bright, clean appearance, and can always be kept in that condition. The extra holes shown in the base, allow the board to be used with three insulators, as shown; or with



McDONALD GLASS HANGER BOARD.

only two insulators, one at each end of the board. When a series of lamps is being hung, the board at the end of the series may be used with two insulators, while all the other boards should be used with three insulators. Thus, when the wire reaches the first board it is tied to the first of the two insulators at the double end. From this point a loop is made for the lamp, and the line wire leaves from the other insulator on the double end. This is repeated on each board of the series, until the last board having only two insulators is reached. On this board the line goes first to the insulator at one end of the board, then through the lamp to the insulator at the other end. From this point it starts back out of the building, using as support the free insulators on all of the boards having three insulating knobs. This makes a neat arrangement of the loops and at the same time a perfect insulation of both wires. The McDonald glass hanger board is being placed on the market by the Electric Appliance Company, of Chicago.

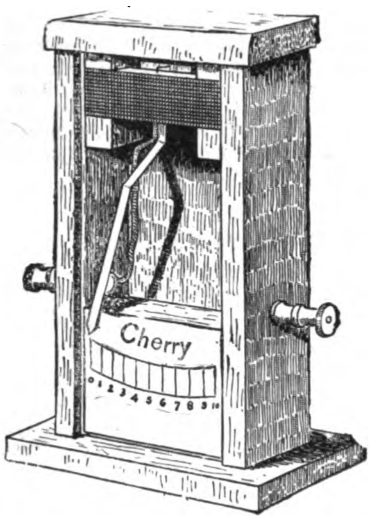
BALL & WOOD ENGINE CO.'S NEW CATALOGUE.

We have received from the Ball & Wood Engine Company, 120 Liberty street, New York, a copy of their new catalogue just issued. It is in oblong form, 9 inches by 12, in a handsome maroon embossed cover, and contains 52 pages of text and illustrations. This company, as is well known, have been highly successful in developing and introducing, first, their simple and compound horizontal engines, their tandem and cross-compound types, and, later, their vertical engines. All these varieties are shown and a great amount of useful and interesting data is given in regard to them and upon the general subject of steam engineering. The views of compound condensing verticals, with valve gear, and those showing the application to dynamos direct or to rope drive, will arrest attention and thought. The company are to be congratulated upon their success and the quality of work and engineering skill with which they have earned it.

CHERRY DIRECT CURRENT AMMETERS AND VOLT METERS.

Electrical measuring instruments are usually beyond the reach of amateurs and students owing to the high price at which they are sold, but the type illustrated herewith is an exception to this statement, its cost being so low as to bring it within the reach of the most slender purse.

As will be seen from the illustration, the instrument consists of a neat wooden case, with a glass face, behind which is the indicating mechanism. The latter is very simple, consisting of a coil at the top of the case, in which is a magnet that takes up a position corresponding to the amount of current passing. To the magnet is attached an index, which moves over a calibrated scale, indicating amperes or volts, according to the winding of the coil used. All metal parts of the instrument are handsomely nickel-plated. The voltmeter reads up to 10 volts and the ammeter up to 10 amperes.



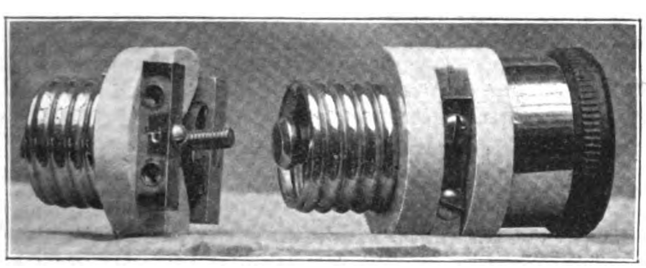
The Cherry Ammeter.

This simple and inexpensive instrument is made by the Cherry Electric Works, 25-27 Third avenue, New York.

THE VETTER CURRENT TAP.

The Vetter current tap, made by J. C. Vetter & Co., 104 East Twenty-third street, New York, is useful wherever there is incandescent electric lighting, as it facilitates the transmission of current to any desired point in the vicinity of the fixture, and thus greatly increases its capacity.

Many offices are supplied with only one or two single wall brackets, and the use of a drop light or fan motor generally means the loss of the lamp, by the substitution of the socket plug for the same at the fixture. The Vetter current tap, however, leaves the lamp where it is, and carries the current to any desired spot; in fact, from a single wall bracket can be obtained by the tap a wall light, a drop light and current for a fan motor. This adaptability makes it very valuable in the sick room, as well as in factories or workrooms, where a good light may be needed directly over an object somewhat removed from the lamp bracket, without losing the light from the lamp bracket itself.


Vetter Current Tap.

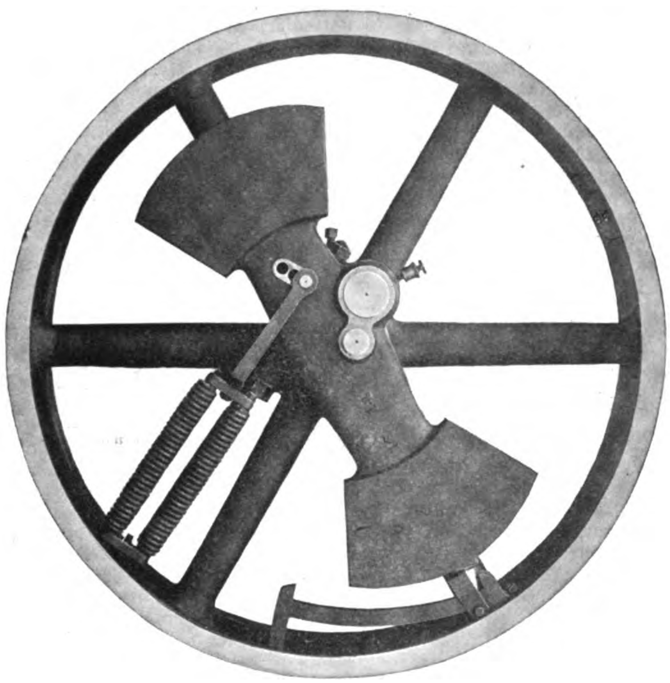
In the medical operating room, the current tap enables the practitioner to have instantly and easily available a portable hand lamp for diagnostic illumination.

The accompanying engraving shows the tap complete, and also the half section. It is made of the best porcelain with hard rubber socket rings.

THE NEW GOVERNOR OF THE BALL ENGINE.

Recent developments in connection with electric lighting in office buildings, insist on such exacting service as to allow only the minutest variation of speed under widely varying loads and changing pressures. Not only must the speed be uniform, but it must remain so during the period of the change. To meet these new and rigid requirements, the Ball Engine Company, Erie, Pa., has, after months of experiment, perfected a governor which in every way fulfils the demands referred to, with the additional beauty of extreme simplicity. This governor, which is an adaptation of the Rites governor system, not only regulates to the very highest degree of perfection, but with an extraordinarily rapid adjustment and without the slightest instability or surging.

Technically stated, the centrifugal element upon which the degree of the refinement of regulation of all governors depends, is combined with an inertia element, relatively so great that instant and extreme changes of load are immediately provided for without waiting for the otherwise necessary manifestation of centrifugal force. The entire governor consists of but a single moving piece, suspended upon one pivotal point, thereby reducing the friction to a minimum, and with no joints to interfere with the best action of the governor. The suspension pin or pivotal point is made of hardened crucible steel. The suspension pin eye is lined with phosphor bronze, and the little lubrication that is required is accomplished by forcing grease by means of a compression grease cup, into a number of recesses arranged around the bore of the bushings. The extreme simplicity of this governor will recommend it to users of engines.


New Ball Engine Governor.

ROWAND'S ORE SEPARATOR.

Mr. Lewis G. Rowand, electrician of the Universal Fire Alarm Company, has recently perfected an entirely new method of electro-magnetic ore separation. The apparatus consists of a belt to carry the ore and two magnets side by side moving at right angles to the belt. By means of a special switch, the magnets deposit the material conveniently which they have attracted as they passed the belt, while the non-magnetic debris is carried further on to be dumped where designated. The machine is specially suited to the separation of ores of low magnetic attractability; and persons wishing to have ores sampled gratis can secure the opportunity by addressing Mr. Henry C. Stewart, secretary and treasurer, 925 Chestnut street, Philadelphia.

NEWTON APPLIANCE COMPANY, 120 Liberty street, New York City, makers of the Newton flush switch, report the following recent large installations of their specialty: Astoria Hotel, Columbia University, the new Delmonico's, Sherry's and the new house of the New York Athletic Club.

RUBERINE PAINT FOR ROOF COATING.

Mr. F. S. De Ronde, general sales agent for the Standard Paint Company, 81-83 John street, sends us the following letter with regard to their ruberine paint: Perhaps it is not known to many of your readers or yourselves, that in addition to the P. & B. compounds and preservative paints manufactured by this company, we also make a specialty of roof coating. We claim to make the best paint in the market for coating and preserving tin and iron roofs. It is the only coating we know of that will effectually fill up large holes that there may be in a metal roof. Suppose for instance, your tin roof was punched full of holes and some one should tell you that they would give you a paint that would fill up these holes. You would no doubt be inclined to disbelieve them. Our Ruberine paint, however, will do this very thing, in addition to which you will note that it possesses extreme elastic properties, which it retains even in very cold weather. We take the liberty of handing you a sample of tin coated with this paint. Same speaks for itself. We should be glad to send to anyone who wishes it, one of these samples along with a good sized package of the paint itself, so that the doubtful ones can make the necessary tests and convince themselves that our material is all that we claim for it. These same remarks as regards to sending samples, also apply to such people as might not know about our P. & B. armature varnish, insulating compounds and tape, if there be any such in the United States. We might say that these latter materials are constantly increasing in popularity, and we are to-day selling more than ever before.

The letter is accompanied by a tin roof treated successfully, beyond any cavil, in the way described.

WESTERN NOTES

CENTRAL ELECTRIC COMPANY, of Chicago, are issuing a very neat and comprehensive small catalogue of electric railway quick break snap fusible switches. These are made in various designs for controlling car light circuits, also in combinations, so that one switch will control two headlights, as well as the car light circuit. The company are distributing these catalogues, to their patrons, and are pleased to furnish them upon request. They are also sending out with these catalogues, circulars of their changeable electric headlights. They have equipped a great many roads with these headlights, and, in every instance, satisfaction has been the result.

J. HOLT GATES & CO., Chicago agents, report good business in the Wagner single-phase alternating current motors. A number are now being installed in the West and giving great satisfaction. This solves the problem of operating power from single-phase circuits. W. D. Ball & Co., consulting engineers, Chicago, who recently installed a motor for pumping water in a large flat building, speak very highly of the performance of the Wagner single-phase motor.

CHICAGO GENERAL FIXTURE COMPANY, 169 Adams street, Chicago, have recently issued a new catalogue of the various electrical fixtures which they carry in stock, which include electroliers, hall lanterns, newels, brackets, portable and ceiling fixtures, pendants, shades and sundry other articles which are used for incandescent electric lighting purposes in offices, buildings or private residences. The catalogue is very tastefully got up and contains a large number of cuts with explanatory reading matter neatly printed in color on plate paper with heavy paper covers. Users of these goods will find a copy of this catalogue useful to have for reference.

ADVERTISERS' HINTS

L. A. CHASE & CO., sole agents for the Elden alternating current circuit breakers, have been receiving numerous communications from users of the instruments testifying to the extreme satisfaction which they give.

ZAMEL ARC LIGHT METER is advertised as a thoroughly reliable device for timing the use of arc lights as well as effecting economy in the consumption of current. The instrument is placed on the market by a company of the same name.

SIEMENS & HALSKE ELECTRIC COMPANY are advertising some new designs and sizes of machinery in the various types which they place on the market.

THE CITY OF NIAGARA FALLS is advertising for bids for the furnishing of arc lights for a period of five years from November 1, 1898. Bids will be received by the Common Council up to and including November 1, 1897.

THE AMERICAN MANUFACTURING COMPANY call attention to the Globe water motor fan, which they are placing on the market, particularly for use where electric current is not available, or the expense of running electric fans is so great as to cause electric motors to be undesirable. The Globe motor is handsome in appearance as well as economical, and is particularly adapted for use in residences.

MR. WALTER C. McKINLOCK, 1108 Fort Dearborn Building, Chicago, is prepared to take hold of a full line of electrical merchandise and is negotiating with several concerns to become their agent. Mr. McKinlock has been connected with the electrical trade for many years, and has a large number of acquaintances and friends throughout the Western territory. He is well known as a man of businesslike nature and sterling qualities.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. SEPTEMBER 2, 1897. No. 487.

ELECTRIC TRANSPORTATION

OPENING OF THE BOSTON SUBWAY FOR THE WEST END TROLLEY CARS.

BY H. W. WELLER, C. E.

After twenty-nine months of continuous and unremitting labor, and the grappling with problems which have taxed the energies of Chief Engineer Carson and his corps of skilled assistants to the utmost, the Boston Subway, or at least a part of it, is about to be opened to public travel. This week the cars of the West End Street Railway are to begin to pass down the incline at the Public Gardens and under the Boylston and Tremont Malls of the Common as far as the loop at Park street. Everyone, from the transit commisioners, chief engineers, and contractors, down to the laborers toiling in the dirt, must be congratulated on the achievement of the first half of the undertaking. Many vexatious but unavoidable delays have been experienced, due to strikes and other causes, besides which many special details of construction have had to be worked out as the various necessities have arisen, and all are to be felicitated upon the result.

The portion now open to public travel includes Sections I., II., III., IV. and V. These consist of a two-track subway commencing at the foot of the incline in the Public Gardens just west of the Westerly line of Charles street and crossing easterly under Charles street and running under the Boylston street Mall of Boston Common to the intersection of Boylston and Tremont streets, where the Boylston street station is located. The four-track subway extends northerly from this station under the Tremont street Mall to a point opposite Temple place where the tracks are spread out and form the Park street station with a two-track loop to accommodate the cars, which formerly ran to the old Tremont House and then returned, while the two outer tracks form the north and south bound tracks for the cars running to and from Scollay square, and Adams square and the Union station. The Shawmut avenue and Tremont street cars will enter the subway by the two two-track inclines forming Section 5, between Pleasant and Warrenton streets, and, after a short length of four-track subway merge into a two-track, which connects at Boylston station with the Boylston street line. It is interesting to note that two sub-subways have been constructed in order to avoid grade crossings, one opposite Common street, to carry the south bound Shawmut avenue cars under the Tremont street tracks, and the other at Boylston station, to carry the south bound Shawmut avenue and Tremont street cars under the West Boylston street tracks. This piece of construction is very instructive from an engineering standpoint.

Having thus briefly described the route a short description of the work in detail may be interesting.

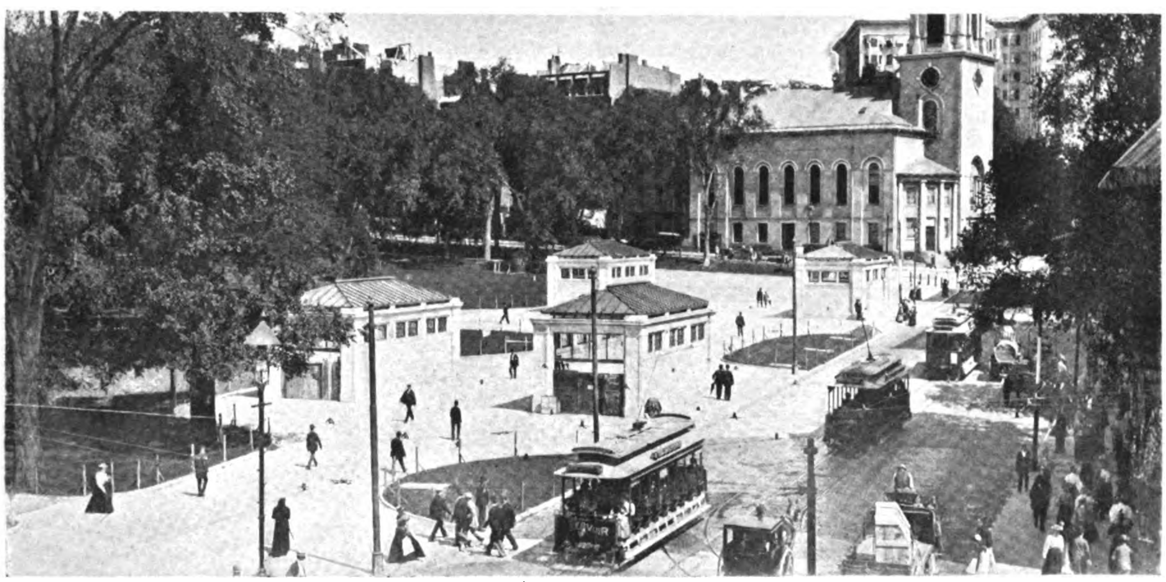
Section I.—On March 23, 1895, the contract for the construction of this section was let to Messrs. Jones & Meehan, and that for the steel to the Pennsylvania Steel Company. The work was commenced at a point in the Public Gardens just west of Charles street, on March 28, 1895.

This section consists of 318 feet of open incline in the Public Gardens, 685 feet of two-track subway from the end of the incline to a point opposite the old Public Library on Boylston street, and 408 feet of four-track subway from the Boylston station under the Tremont street Mall of the Common, ending near West street.

The open incline was excavated in the usual way and substantial granite retaining walls were constructed upon concrete foundations, piling being driven where necessary, with a masonry invert upon which the ballast is laid to carry the ties of the tracks.

In the two-track subway, after the excavations were made in open cut, the masonry and concrete foundations for the steel work were put in and the steel work erected upon them. This portion of the subway consists of steel posts, 6 feet apart along either side, with concrete around and between them. The steel cross beams for the roof are supported on these posts, and trussed or braced across the angles, and the spaces between the beams are filled in with brick arches upon which concrete is laid and waterproofed, and the surface material filled in. The invert is of masonry and cement concrete with an open channel with flag stone cover running along the middle to provide for proper drainage. A vitrified stoneware drain was laid below the level of the invert, to carry any drainage water during construction to the pump well in the Public Gardens. This drain and the various relief drains were afterwards carefully plugged. A four-inch course of concrete was laid below the masonry invert, wherever below the ground water level, and then covered with an asphalt layer extending to and joining the asphalt waterproofing behind the side walls. The concrete forming the side walls was carefully plastered with Portland cement and a coating of asphalt applied, and this asphalt waterproofing was continued over the roof.

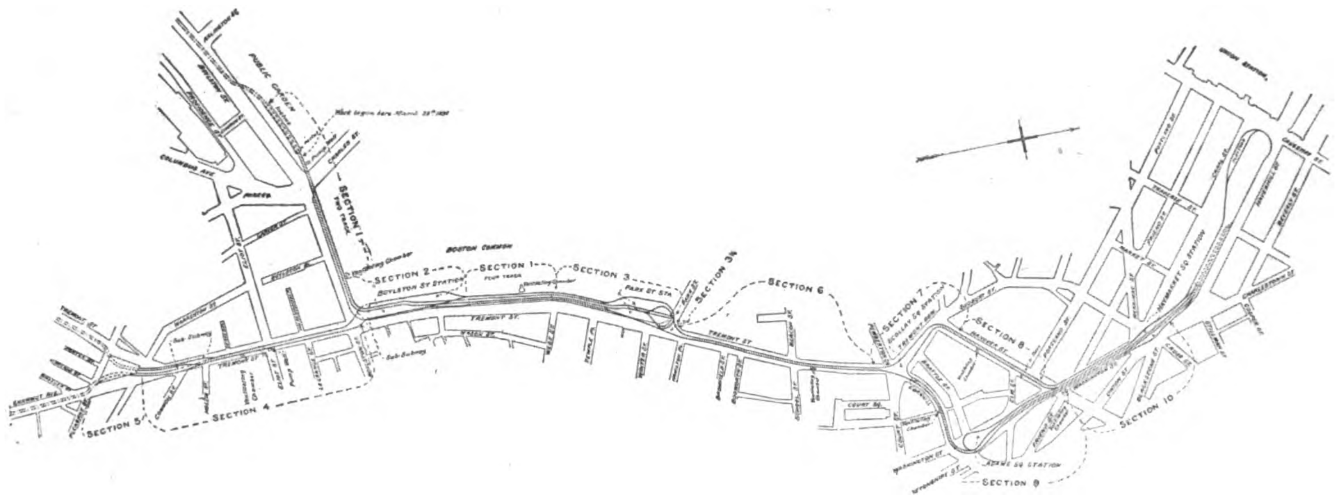
In order to further protect the steel from moisture a vertical course of ribbed tiles was carried up outside the waterproofing



Boston Subway Station Entrances, Park Street, Boston.

to the height of the ground water level, and behind this again was laid a course of brick covered with asphalt. Every 6 feet a 2 inch stoneware pipe was laid through the side walls from the bottom of the ribbed tile to the inside of the subway, thereby preventing any water from collecting behind the walls. The pump chamber in the Public Gardens is connected with the adjacent street sewers by an 18 inch drain, with the necessary manholes. An automatic back flap valve is provided to prevent the passage of water from the sewer back to the pump chamber.

The four-track subway consists of an open excavation the full width of the work, the opposite banks being braced against each other, across the trench, during the construction of the side walls. At the commencement, three trenches were made down to the grade, one on each side and one in the middle for the centre line of columns, but it was soon found practicable to open the entire width at once. The footing stones for the columns or posts were laid on concrete, and the iron work, consisting of the three longitudinal rows of columns supporting the roof beams, were erected upon them. From the hollow in the grade, south of West street, a 15 inch drain carries any drainage to the pump well at Eliot and Tremont streets.



Map of the Boston Subway for the West End Trolley Cars.

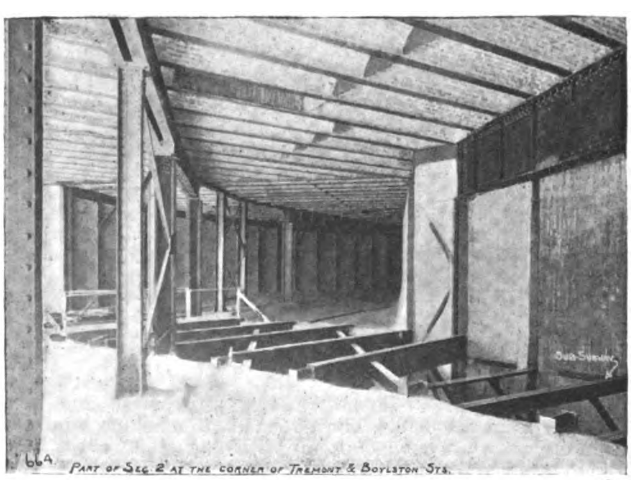
A masonry ventilating chamber has been constructed near the old burying ground in the Common and is supplied with a 7-foot fan, to be driven by a 500 volt General Electric motor. A similar but larger chamber is located in the west side of the four-track subway, a little south of West street, in which is installed an 8-foot fan to be belted to another 500 volt General Electric motor.

Section II.—This section practically consists of the Boylston station and approaches. It also includes a two-track subway of about 210 feet in length under the Boylston street Mall, connecting the two-track portion of Section 1 with the above station. The station section proper is 634 feet in length and connects at its northerly end with the four-track portion of Section 1, under the Tremont street mall. The station consists of four tracks and two island platforms, each about 30 feet wide. The platform nearest Boylston street and on the east side of the subway is for the north bound passengers and is about 340 feet in length, and that opposite Mason street and on the west side of the subway is for south bound passengers and is about 230 feet in length. The two platforms are connected by a sub passageway, 6 feet wide with a short flight of stairs at either end. Four wide stairways are provided leading to the surface of the Tremont street mall, two to each platform. The outward bound Tremont street track descends from the southerly end of the southward bound platform by an 8 per cent. grade, and round a necessary curve, passes easterly under the two Boylston street tracks, and then ascends a 4½ per cent. grade to its proper level. Numerous sidewalk lights are provided in the roof to help to light the station.

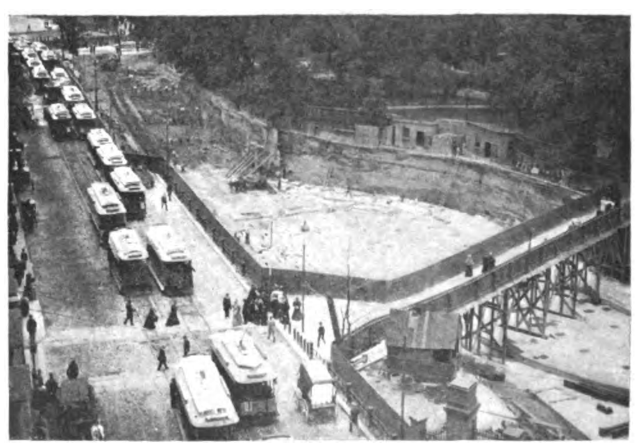
The same general design of construction of steel and concrete and masonry is followed as in Section 1. The concrete filling for the top of the arches is sloped from the middle to each side, to shed the water, and the roof and sidewalls are coated with asphalt mastic ½ inch to ¾ inch thick. Wherever the subway is less than 10 feet above mean low tide it is protected with hollow ribbed tiles coated with asphalt on each side. The whole of the drainage is conducted by stoneware pipes to the pump wells at Eliot street and in the Public Garden.

The Charles street pump well, near the Public Gardens, is provided with two 5 h. p. 500 volt motors, Gen. Elec. make, with automatic float control, and two No. 3 B. pumps, made by the Lawrence Machine Co., and at the Eliot street pump well are installed one 5 h. p. similar motor, connected to one No. 3 B. pump, made by the Lawrence Machine Co., and one 10 h. p. motor connected to a No. 4 B. pump, also made by the Lawrence Machine Co.

One of the many difficulties met with in the work was the



Building Section 2: Corner of Tremont and Boylston Streets.



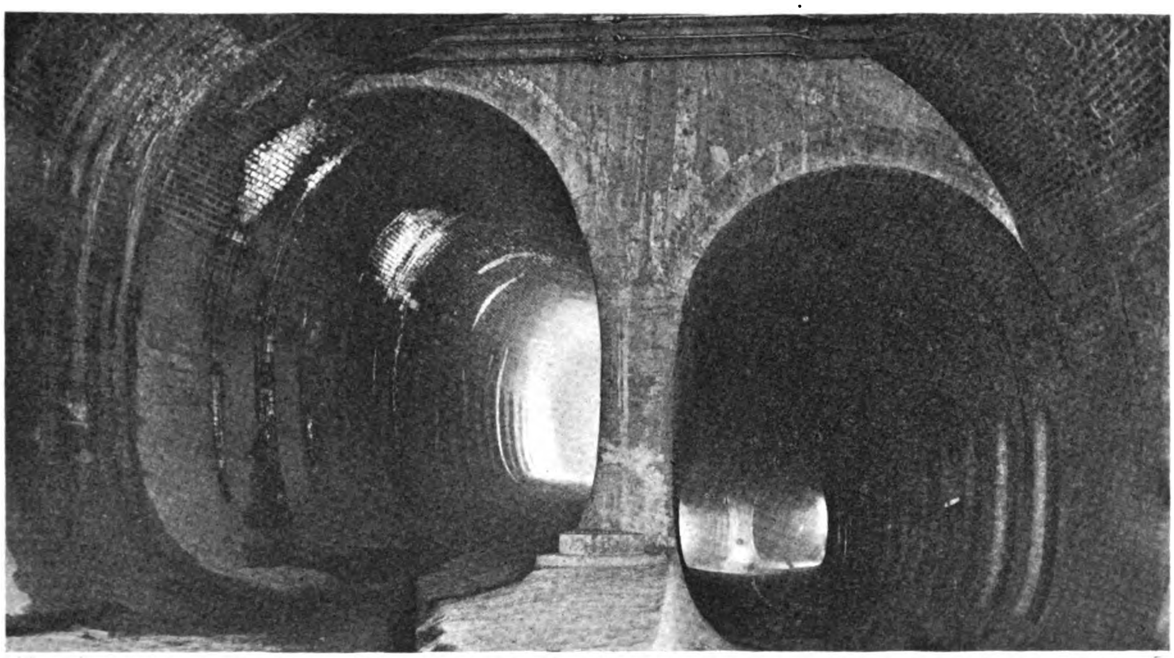
Preparing the Subway.—Looking Southerly on Tremont Street —Car Blockade.

crossing of two large water mains, 30 inches and 40 inches in diameter, respectively, diagonally across the line of the subway, a little south of Mason street. As these pipes were at a level below the roof of the subway and 15 or 16 feet above the invert, it was necessary to construct a syphon to pass down and under the invert and up again to the proper level. To provide for this in a proper manner, a concrete and brick conduit 10 feet in diameter was constructed in which the pipes could be laid and at the same time be accessible for repairs. The water mains are carried vertically downward at either end about 23 feet, and laid through this conduit. The conduit has built into it a series of steel bands or hoops, 2 inches wide and ⅛ inch thick, to strengthen it in case of serious leaks from the water mains. Special construction of "I" beams and brickwork is provided wherever the subway columns are near or resting on the conduit. A chamber, 10 feet by 18 feet, is provided at each end of the conduit for ready access for repairs. Two ⅛ bends are used to change the direction of the pipes from vertical to horizontal and vice versa. The upper elbows are trussed by steel harness connected to "I" beams anchored in the concrete.

Section 3.—This section consists of a four-track subway, about 300 feet in length, from the four-track portion of Section 1, north of the Boylston street station and the Park street station, or as it is more generally called the "Park street loop." The station consists of two island platforms, the easterly one, about 250 feet in length, being for the north bound, and the westerly, about 275 feet long, for the south bound, traffic. These platforms are irregular in shape, their greatest width being about 40 feet. Each platform is connected with the street by two independent stairways. The loops are provided so that cars on routes terminating at Park street can be sent on their return journey without switching and its attendant delays. Proper side tracks for holding extra cars or cripples are provided inside the loops, together with suitable pits under the tracks for inspection of motors and temporary repairs. The construction of the four-track portion is similar to that of Section 1, and that of the Park street station is practically the same as for the Boylston station. At the northern end of the station the two outside tracks, after passing around the loop, converge into two separate single track subways (Section 3½), which join Section 6 in the bell mouth opposite the Park Street Church. In connection with the construction of Section 3 the historic soil of Boston Common was trespassed on by the cars of the West End Street Railway Co., while the easterly portion of the station was being completed.

Section 3½.—This section, consisting of two short portions of single track work, was constructed at the same time the extensive changes in the sewers adjacent to Park street were made, hence the necessity for treating these as a separate section.

Section 4.—This section connects the Boylston station with the station at the junction of Shawmut avenue and Tremont street. It consists of two separate single track subways, one for the south bound cars at a lower level, 39 feet below the street at Boylston street, that for the north bound cars being only 23 feet below the surface. These two subways converge into a double barrel subway opposite the new Hotel Touraine, both being brought to the same level before reaching Eliot street, where the two tracks are carried in a wide single arch subway, and near Hollis street the westerly track is depressed and branches into another double bell mouth, one side for the south bound Tremont street cars and the other for the south bound Shawmut avenue cars, while the easterly barrel rises until it crosses over the south bound Shawmut avenue subway to carry the north bound Tremont street cars without a grade crossing. This portion of the work represents considerable engineering skill and thought, and the result is highly gratifying. From Boylston street to Common street this section consists of concrete sides and floors with brick arches filled in with concrete for the roof. In the wide arch subway, iron tie rods, 1¾ inches thick, are placed two feet apart to protect the brick arch from spreading. Refuge niches are provided every 6 feet. Vertical "I" beams are imbedded in the concrete in the two track subway to strengthen it, and these, like the rest of the iron work, are connected with tinned copper wires, and proper provision is made to guard against electrolysis. The rest of this section, southerly, consists of side walls of steel posts and concrete, with iron roof girders and brick and concrete arches. In order to interfere as little as possible with the daily traffic on the streets, this portion of the work was carried out by the slice method, as it is called, or in other words, short lengths at intervals, were opened up and constructed and ultimately joined together by the completion of the intervening slices. This also considerably lessened the chances of damage to adjacent buildings, etc.



SECTION 4.—HIGH AND LOW LEVEL TUNNELS CROSSING.

Section 5.—This section consists of the two 2-track inclines at the junction of Shawmut avenue and Tremont street, and the short length of four-track subway connecting these inclines with the southerly end of Section 4. The triangle enclosed by the two inclines will be arranged so that it can be used as a station with a wide platform between the two inclines, and two narrower ones on the outer side of each incline. This station will also be adapted for building over it a fireproof structure of several stories in height which can be used for an apartment block. This triangle was covered with old buildings which were removed under contract by Messrs. Elston & Sons, early in May of last year.

The remainder of the subway, most of which is completed but not yet open for traffic, comprises Sections 6, 7, 8, 8½, 9 and 10, with the necessary stations at Scollay, Adams and Haymarket squares.

ELECTRIC CONDUITS.—Considerable work in removing and replacing, or relocating the electric conduits had to be carried out besides the various changes in the water and sewer pipes, in many cases special provisions having to be made to

accommodate them. The following gives the number of lineal feet of duct which was relocated in Section 2, 3 and 4:

	Removed, feet.	Laid, feet.
Edison Illuminating Company:		
Section 2.—2½ inch duct	277	273
" 3.—2½ inch duct	52	52
" 4.—2½ inch duct	91.5	92.5
" 4.—3 inch duct	168	170.5
Boston Electric Light Company:		
Section 4.—3 inch temporary	...	591
" 4.—4 duct conduit	404	...
" 4.—2 duct conduit	87	...
New England Telephone & Telegraph Co.:		
Section 4.—3 inch temporary	...	146
" 4.—3 duct conduit	146	...
" 4.—2 duct conduit	45	...
Totals	2,906.5	1,415

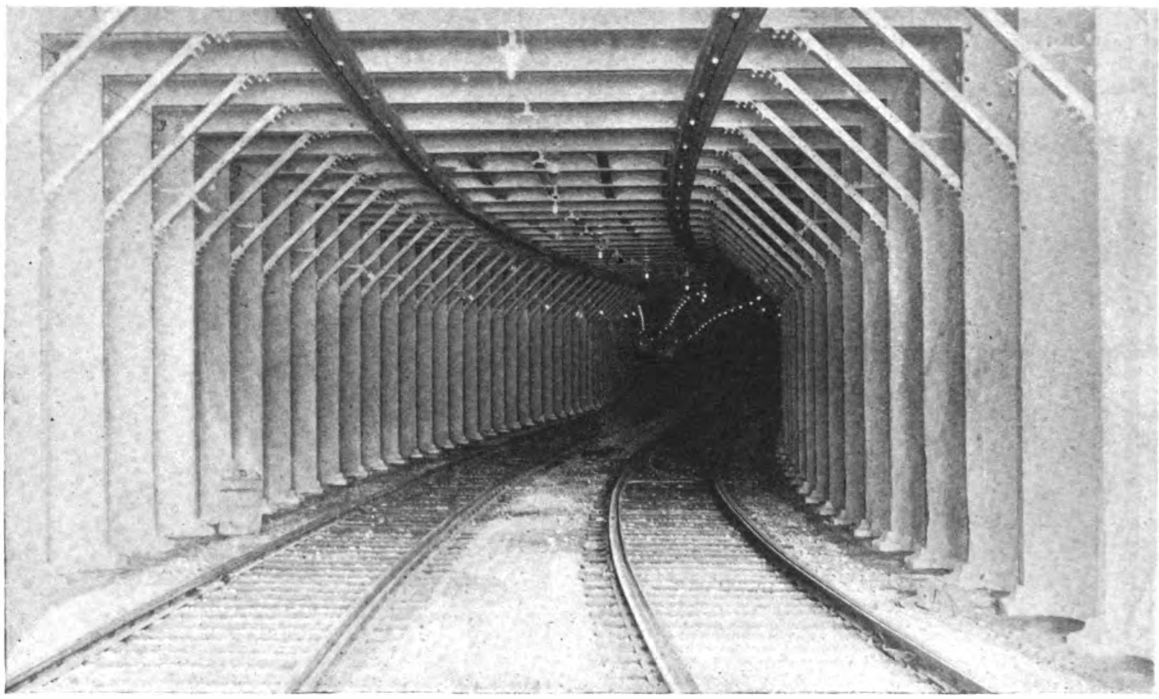
Much of the work necessitated by the construction of the subway, but not a part of the subway proper, while very interesting, containing so many and varied problems, each of which had to be taken up and decided on its own individual requirements, hardly falls within the scope of this article, but the underpinning of high buildings, the raising of large water mains, changing the location of sewers and electrical conduits, and even the lifting and transplanting of living forest trees, were undertaken and carried out with success.

The contractors for the steelwork and construction on the various sections are as follows:

Section.	Steelwork.	Construction.
1	Penn. Steel Company	Jones & Meehan.
2	" " "	E. W. Everson.
3	" " "	F. E. Shaw.
3¼	Boston Bridge Works.	
4	N. J. Steel and Iron Co.	Metropolitan Construction Co.
5	Boston Bridge Works	Wm. H. Keyes.
6	Berlin Iron Bridge Co.	R. A. Malone.
7	Carnegie Steel Co.	Shailer & Schniglau.
8, 8¼	A. & P. Roberts Co. Pencoyd Iron Works	Metropolitan Construction Co.
9	" " "	Richardson & Young.
10	Carnegie Steel Co.	Shailer & Schniglau.

THE TRACK.—The track is laid with tee rails, Am. S. C. E. standard, weighing 85 pounds to the yard, with continuous joints. Each rail is protected for its entire length by a guard rail of special section weighing 45 pounds to the yard, being bolted to it. The rails are spiked to oak ties which have been thoroughly treated with "Woodaline," to shed moisture and thereby ensure their proper insulation, and increase their durability. The ties are laid on broken stone and carefully ballasted with it. Each rail joint is connected with two 4-0 copper bonds, and every 500 feet all the tracks are properly bonded together and cross connected, and returned to the station by 500,000 c. m. cables. If found necessary a separate return to the power station will be established for any leakage current that may be collected from the ironwork of the subway, in order to prevent electrolysis.

OVERHEAD WORK.—A suitable inverted wooden trough is securely fastened to the ironwork of the roof and insulated with sheet rubber. Car barn hangers are set in flush into this trough and insulated with sheet rubber between the hanger and the trough. An insulating bolt of the Anderson pattern, and carrying a special mechanical clip designed by the engineers of the West End Company, supports the trolley wire, which is of special "figure of 8" shape, section having an area of about 360,000 c. m. These hangers are placed 12 feet apart on straight track, and 6 feet apart on curves. This construction is at once very rigid, simple, and workmanlike, and almost entirely eliminates the arcing of the trolley, so noticeable on the Nantasket Beach line, where the "figure of 8" wire is used, but suspended differently. The current is taken temporarily from the present underground feeder system of the West End Railway Company, but in the near future a new conduit with 500,000 c. m. cables will be laid direct to the central power station for supplying power to the subway alone. The whole of this portion of the subway from the entrance to the Park street loop is controlled from one section box, but any one track can be cut out at will, when necessary.



Boston Subway: Method of Illumination and Trolley Suspension.

LIGHTING SYSTEM.—The subway is lighted throughout by electricity, both incandescent and arc lamps being used. There are, in the opened portion of the subway, 600 incandescent lamps of the Bryan-Marsh make, and fifty-five enclosed arcs, some of them of the well known "Manhattan" make, and some supplied by the General Electric Company. Besides these there are 20 direct current high tension arcs, supplied by the Boston Electric Light Company. The incandescent lamps are run in lines on either side of the subway and also between the tracks. The lamps are placed about 36 feet apart on the lines, and the line circuits are alternated so as to properly distribute the lamps. The regular railway circuit is used, but the power for one of the circuits or lines is supplied from the Dorchester power station, and that for the other lines from the Central power station. The lamps are run 5 in series.

The enclosed arcs are used for lighting the subway stations, and are run from the same power stations, and are also 5 in series.

There are also 20 direct current arcs, in the stations, run from the lines of the Boston Electric Light Company. These will probably be operated for 12 hours per day, and will al-

ways insure light in the stations in case of any blowouts in the railway power stations.

The switchboard for all the lighting of this portion of the subway is placed in a large room, beneath the junction of Boylston and Tremont streets, and consists of three black marbleized slate panels installed by the General Electric Company fitted with three of their type of automatic circuit breakers of a capacity of 500 amperes each. One of these is connected to the 500 volt incandescent circuit of the Boston Electric Light Company, one to the Dorchester power station, and one to the Central Power Station. The switchboard is also supplied with three round pattern Weston ammeters, and with six double-pole double-throw switches, which can be used in emergency to throw all the incandescent lamps on to the service of the Boston Electric Light Company, although all these will ordinarily be run from the West End Company's power station.

The power can also be taken entirely from the Dorchester or the Central Power Station at any time by the opening and closing of the switches.

In the rear of the switchboard is a feeder board having 22 quick-break, knife-blade switches, together with porcelain cut-outs, which handle the various circuits, and putting the entire control of the lighting of the subway South of Park street in the care of the operator at this switchboard.

There is also a system of electric block signalling in process of installation to guard against accidents to cars standing in the Boylston street station. This is more or less an experiment, but if successful, it will be operated permanently.

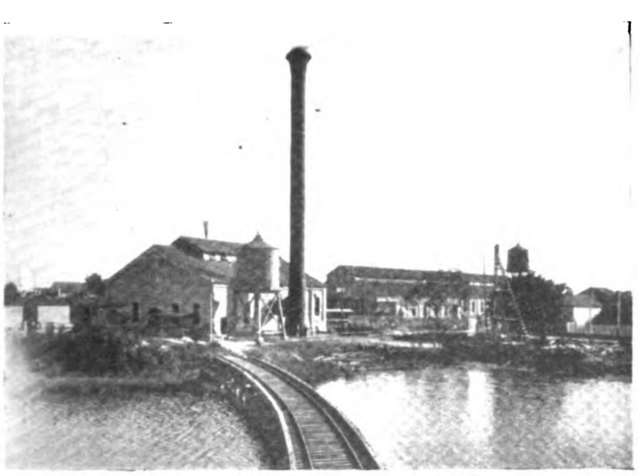
Electric heaters are located in the ticket offices, but the stations are not heated at present, as it is expected the temperature will not fall low enough to require it, even in the coldest weather.

The electrical and track work has been laid out and installed by the West End Street Railway Company under the direction of Mr. C. F. Baker, their able master mechanic.

In conclusion the writer wishes to express his thanks to Chief Engineer Howard A. Carson for his courtesy and permission to inspect the works from time to time, and also to Mr. G. P. Goodman, his photographic assistant, for his valuable help.

THE POWER HOUSE AND CAR BARN OF THE CHARLESTON CITY RAILWAY COMPANY, CHARLESTON, SOUTH CAROLINA.

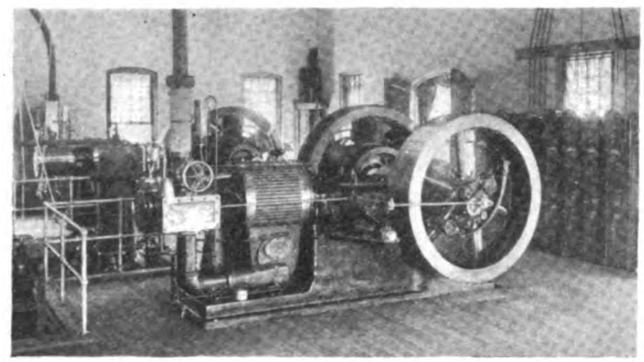
ONE of the latest of the larger cities in the South to adopt electric traction has been Charleston, S. C., but in this respect that much-tried city has been very fortunate, as it is certainly benefitting by all the latest experience and study of the subject. The service that it now enjoys will compare most favorably with that in any part of the Union, and the instant popularity of it has proved that it meets a demand of the most pronounced character. The Charleston City Railway Company, owned now by New York capitalists, absorbed the



Power House and Car Barn, Charleston, S. C., City Railway.

other roads in the city, so that the public has the advantage of a strong management and of the best facilities for local inter-communications, due to the reforms rendered necessary in changing over from a slow and intermittent mule service to a rapid, frequent electrical system. The whole work, both of a consulting and of a contracting character, has been done by the firm of J. G. White Co., New York City, in whose hands every detail has received as usual the most thorough care and attention, as will be seen from the accompanying data and illustrations:

CAR HOUSE.—The car house is located on a lot 184 feet by 312 feet, at the corner of Meeting and Pointset streets. It is built of brick and its outside dimensions are 255 feet 3 inches by 67 feet 8 inches. An office building 71 feet 4 inches by 17 feet 4 inches is built alongside the car house. The distance from top of rails to under side of roof trusses is 18 feet. The



Ball & Wood Engines, Direct Connected, Charleston, S. C., Railway Plant.

car room is 209 feet 4 inches by 65 feet, and there are armature and store rooms and a repair shop at the rear end of the building. The main car room contains three pits, each 100 feet long, and the repair shop contains two pits 26 feet long. The elevation of the floor of the car barn is 11.5 feet above low tide.

On excavating for the foundations, water was encountered a few feet below the surface, and the ground was found to be a fine sand, mixed with loam, and of very little supporting power. To avoid piling, the foundations were not carried more than 2½ feet to 3 feet below the surface.

Test pits, excavated to a depth of six feet, led to the conclusion that shallow foundations would be likely to cause less trouble from settlement than deep ones.

Under all the exterior walls there was laid a footing of Portland cement concrete 3 feet 4 inches wide and 2 feet thick. On this concrete footing the brick footings were laid and the structure was completed in the usual manner—no other precautions being taken to prevent settlement or cracking of walls.

Below the ground line, all the brick work was laid in cement mortar, and above the ground line in lime mortar.

All the interior partition walls are brick and rest upon concrete footings, similar to those under exterior walls. The walls of the pits are brick, laid in cement mortar, and all pits have concrete bottoms.

The floor of the car room and the floor of the paint shop are concrete, with a finishing coat of Portland cement mortar, troweled smooth and flush with the tops of the rails. All exterior walls are 12 inches thick in panels, and are 20 inches thick at pilasters. The roof trusses are steel, and the roof covering is No. 20 corrugated iron. A monitor 27 feet wide extends the whole length of the building, and all sashes are arranged to be opened and closed from the floor.

The interior walls are kalsomined, and the trusses and under side of corrugated covering are painted a light color.

The car house contains five tracks, 11 feet 6 inches apart center to center, and the center of one side track is 12 feet from side wall of building to allow room for convenient handling of repair parts and to form a passage way to the rear of the car room.

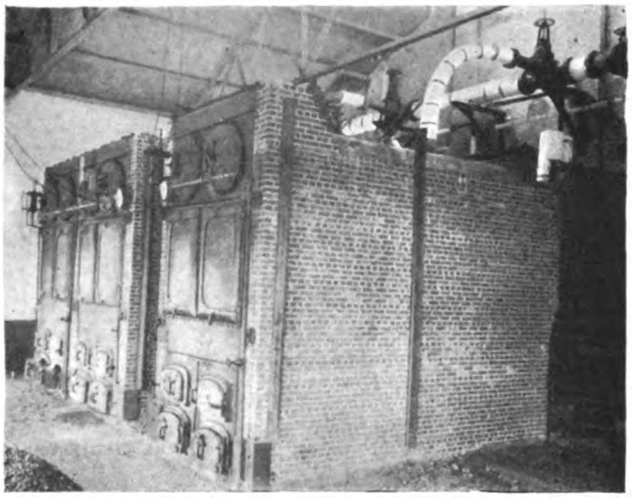
The office building contains superintendent's office, conductors' and locker room, and shower baths. Basins and shower baths have been liberally provided for the purpose of encouraging personal cleanliness on the part of the employés.

POWER HOUSE.—This is located on a lot 300 feet by 355 feet, fronting on Meeting street, and extending from Centre street to Coolblow street. This lot is directly opposite the lot on which the car house is built, and about half the lot is under water.

In designing the power plant the object aimed at was to secure a thoroughly substantial and reliable plant, with the least possible expenditure of money. The building is a plain, substantial, brick structure, designed for the sole purpose of housing the machinery.

The power house is 85 feet by 68 feet 4 inches, and contains

a boiler room 45 feet by 65 feet and an engine room 36 feet by 65 feet. The exterior walls are brick, 16 inches in panels, and 20 inches thick in pilasters. The foundations and concrete footings are similar to those of the car house. The partition wall between the boiler and engine rooms is brick, 12 inches thick, with pilasters 16 inches thick. The clear height between floor of boiler room and under side of roof trusses is 22 feet. The engine room floor is 4 feet 6 inches above the boiler room floor. The roof trusses are steel, and the roof covering is No. 20 corrugated iron. The roof is continuous over



BABCOCK & WILCOX BOILERS, CHARLESTON POWER HOUSE.

both the engine and the boiler rooms, and a monitor 27 feet wide extends nearly the entire length of the building.

The floor of the engine room is constructed of 10 inch by 12 inch joists on brick piers; the under floor is 4 inch thick plank, and the top floor is 1 inch maple. The floor of the boiler room is brick, laid on edge on a 4 inch thick bed of concrete and grouted flush.

All interior walls are rubbed smooth and kalsomined in a light color. That part of the roof over the engine room is ceiled with hard pine, nailed to spiking pieces, which are bolted to the steel purlins, and the ceiling is finished in hard oil finish.

The boiler room contains two 200 h. p. Babcock & Wilcox boilers, set in one battery, and one 200 h. p. B. & W. boiler, in a separate setting. Provision has been made for two 300 h. p. B. & W. boilers, which will be installed later. There are two Deane 7½ inch by 4½ inch by 10 inch duplex boiler feed pumps, and one 7½ inch by 6 inch by 10 inch duplex tank pump. The engine room contains two Ball & Wood 14 inch by 27 inch by 16 inch tandem compound condensing engines, and two direct connected 200 k. w. G. E. generators, running at 200 revolutions. The foundations for the engines are carried on piles, about three feet apart and "driven to refusal." Piles were also driven for foundations for a 500 h. p. engine to be installed later. The heads of the piles under each engine are encased in a bed of Portland cement concrete, 3 feet thick, and forming footings on which to commence the brick foundations proper. The footings for the partition wall between engine and boiler room are carried about 8 feet below the floor of the boiler room, and form one wall oof the condenser pit in the engine room.

STEAM DETAILS.—The walls of the condenser pit are brick, laid in Portland cement mortar, and the bottom is Portland cement concrete 18 inches thick. Owing to the bottom of the condenser pit being level with high tide, and at least three feet below the ground water level, it was necessary to construct it water tight and to provide a steam ejector for removing any water which might escape from the pumps and condenser.

The walls of the pit are independent of engine foundations. The condenser is a 14 inch by 22 inch by 24 inch horizontal single Deane jet condenser. The boilers, piping, engines and auxiliaries were designed to be operated under 175 pounds steam pressure. All piping is full weight standard pipe, or extra heavy, and all steam fittings, larger than 2½ inch, are gun iron, having a tensile strength of not less than 29,000 pounds.

Stratton separators are used on the steam pipes to the engines, not so much to take care of condensation as for protection against possible priming due to bad water.

There is one 600 h. p. vertical Goubert feed water heater in the condenser pit, and the exhaust piping from the engine is arranged so that the exhaust may be passed through the primary heater and condenser, or through the primary heater to the atmospheric exhaust, or directly to the condenser, or directly to the atmospheric exhaust.

The injection water inlet to the condenser is 19 feet above the supply. A 4 inch priming pipe connects with the general water supply system, and enables the condenser to be readily started.

A bridge spans the condenser pit at the point at which the valves in the injection, priming and steam pipes are located. The steam supply to the condenser is led around so that all the valves controlling the operation of the condenser are located within easy reach of the operator when standing on the bridge referred to. A valve is also placed in the steam pipe close to the condenser, so that its operation may be controlled from the floor of the pit.

The exhausts from the condenser, and from all pumps, discharge into an auxiliary exhaust pipe which connects with a 600 h. p. vertical Goubert supplementary heater, set in boiler room, and with the atmospheric exhaust. The main atmospheric exhaust pipe is 14 inches in diameter, and extends above the roof of the power house, where it terminates in a condenser head. The valves are all of the Chapman make.

All drips from the high pressure steam system are led to a Deane receiver and Duplex plunger pump, which automatically returns to the boilers the water of condensation. The feed water piping is 3 inch extra heavy and is arranged to pass the feed water through the primary and supplementary heaters, or through either of them, or directly to the boilers. Owing to the fact that the best feed water obtainable contains a large amount of salt and scale forming impurities, provision has been made for installing a feed water purifier later, if it should be found necessary to do so. In the engine room there is a gauge board, having steam and vacuum, needle and recording gauges.

There is a steel chimney 125 feet high and 7 feet diameter at top, erected on one side of boiler room, about five feet from building, and a plate iron breeching connects the boiler settings with the chimney. The main damper in the breeching is controlled by a Spencer automatic damper regulator, placed in the engine room. The steel chimney is lined throughout and the flaring bottom section is filled in solidly to increase stability. The chimney foundation consists of piles, capped with a bed of concrete, 21 feet square, supporting the brick base as shown. The chimney was built E. Keeler & Son.

A 30,000 gallon wooden tank erected on a wooden tower, 20 feet high, alongside the power house, supplies feed water for the boilers. A 30,000 gallon wooden tank, erected on a steel tower 39 feet high, alongside the car house, furnishes water supply for car washing and fire protection; 2½ inch hose valves are located in the car house and in the power house. The discharges from the three pumps in the boiler room are so arranged that any one, or all of the pumps, can be used to feed

TRACK CONSTRUCTION, BROAD AND MEETING STREETS, LOOKING NORTHEAST, CHARLESTON, S. C.

boilers, or to pump into either of the tanks and in the fire protection system of piping. The tank on the 39-foot tower alongside the car house is supplied through the general fire protection system of piping. The 6 inch rising pipe connects directly with the bottom of the tank alongside the car house. The 2½ inch general supply passes through the bottom

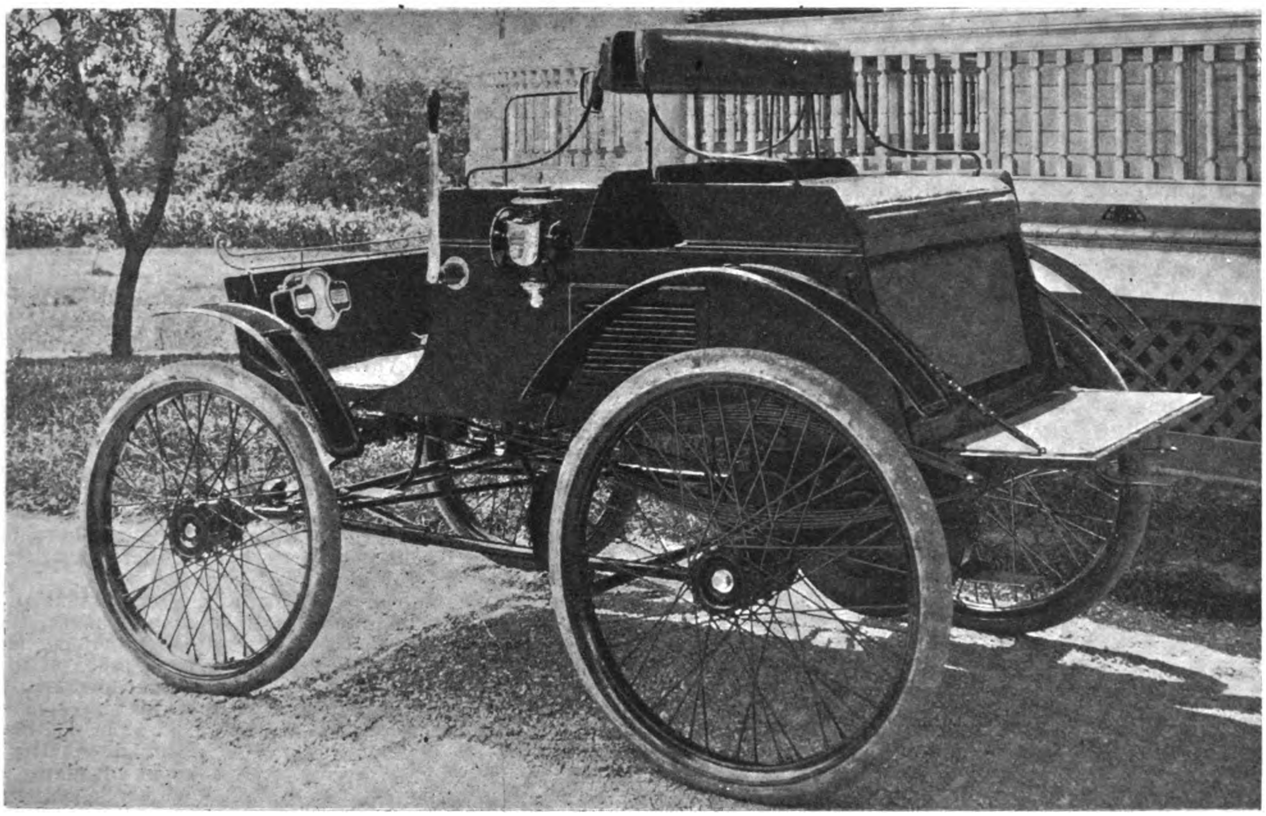
and terminates about eight feet above the bottom of this tank. This 2½ inch general supply furnishes water for car washing and other purposes, and the object in carrying it 8 feet above the bottom of the tank was to prevent the possibility of the tank being emptied through this pipe, leaving no water for use in case of fire. In order to obtain for fire purposes a head of water due to a 100-foot tank tower, and at the same time save the difference in cost between a tank on a 100-foot tower and one on a 39-foot tower, a special arrangement of piping was devised. With all hose valves closed the pumps deliver into the fire protection system of piping until the pressure reaches 50 pounds, at which pressure the automatic relief valve opens and the water passes through it and into the tank, through the 6 inch rising pipe. In case of fire, occurring at a time when the pumps are not delivering into the fire protection system of piping, on opening any of the hose valves water would be supplied from the tank through the 6 inch horizontal swinging check valve until the pumps were started and delivered more water than could be discharged through hose, when the horizontal swinging check will close and the pressure rise to 50 pounds, and the surplus water pass through the relief valve to the tank. In case of an accident to the pumps during a fire, the horizontal swinging check valve would render all the water in the tank available, but under reduced pressure. Each hose valve is provided with 100 feet of 2½ inch hose, and 1 inch nozzle, with the exception of the two hose valves in the engine room. The two hose valves in the engine room turn down and discharge directly on the floor. A base about 4 inches high has been constructed around the condenser pit to support a railing, and to act as a dam in case it should be necessary to flood the floor of the eingine room on account of fire. The floor of the engine room being the only combustible part, provision was made for flooding it and hose excluded.

MAIL BOXES ON STREET CARS.

The Postoffice Department has received a report from Des Moines, Iowa, where an experiment is being tried of having letter boxes attached to all the street cars and a large share of mail collection taken up by them. The cars in Des Moines all run past the postoffice. They stop at all places to receive a letter or other mail matter and, as they come by the postoffice, a carrier takes the mail from the boxes. During July there were collected by this means 29,237 letters, 6,059 cards and 441 pieces of second, third and fourth class mail matter. It shows an increase of 1,300 pieces over June, and the postmaster thinks that, as many cars were open and no boxes attached, not so much was collected by this means as if all the cars were closed. If the experiment be successful, it will be tried in other cities.

NEW RIKER ELECTRIC CARRIAGE.

MR. A. L. RIKER, of the Riker Electric Motor Company, Brooklyn, has brought out a new and interesting type of his electric carriage, which is illustrated in the accompanying engraving. As will be seen, it is a four-wheel, four-seated vehicle, with low front dashboard, and with seats back to back across the carriage. The weight complete is 1,800 pounds only. The wheels are 32 inches in front and 36 inches rear, fitted with 3-inch pneumatic tires. The body is black and the running gear dark green with red stripes. There is one Riker motor, normal 2 k. w. capacity, weight 142 pounds, driving upon the rear axle, 1,000 revolutions per minute, and making single reduction at a ratio of 9 to 1. The motor and gear case are entirely enclosed, being waterproof and dust proof. The axle is double, the motor being fixed upon the outer stationary axle or sleeve. The batteries are of the zinc-lead type, of special design, and weigh 760 pounds, there being 36 cells, each 7 inches long, 3½ inches wide and 9 inches high. They give 150 ampere hours at the 10-hour rate of discharge and 120 at the 4-hour rate. They are apparently both cheap and durable, and Mr. Riker expects a great deal from them.



RIKER'S NEW ELECTRIC "STANHOPE."

The steering is done by the vertical handle seen in front, which has so light a movement that finger pressure will govern it. It applies by toggle joints to the wheels of the front axle and makes an extremely neat and quick turn with the wheels, independently of the position of the carriage body. The controller is the lever seen on the left of the carriage. It works backward and forward, and the direction of its travel corresponds with that of the carriage. There are three regular speeds, and the carriage can, if necessary, be run as high as 25 miles an hour. On the dashboard in front of the driver, is a combination testing instrument, reading for both volts and amperes, and so legible that the driver can easily see the indications from his seat. This instrument has been specally built by the Weston Electrical Instrument Co. The carriage has also an electric bell, headlight and two side

lights. It operates very smoothly, and Mr. Riker says he has endeavored to free it from conventional lines, so that the driver or passenger would never know from looking at it, that such an animal as the horse was once in existence. The charging connections are under the flap of the rear seat, and the rheostat enables the carriage to be charged on any straight, multiple circuit it is likely to find available anywhere, from 80 volts to 500. A number of these handsome carriages have already been ordered, and Mr. Riker thinks that their price does much to bring the horseless vehicle within the reach of every-day users. He is also building delivery wagons on the same general lines.

EDUCATIONAL BONDS.

BY PROF W. M. STINE.

IN The Electrical Engineer for July 29 there appeared an editorial, "Colleges in Poverty," which was full of suggestion. It presented a problem which is yearly growing more apparent. The past two decades have been pre-eminently distinguished by the number and amounts of endowments for founding or enlarging institutions of higher literary and professional training. Of the most notable gifts, scarcely one has escaped more or less serious financial depreciation and loss; and it is apparently an easier task to secure a large endowment than it is to invest it advantageously and permanently.

Several years since President Thwing pointed out several pertinent facts relating to the investment of college funds. The college funds of the country are invested with more uniform success than those of other corporate bodies. They call to their aid the best financial judgment and experience of many of the ablest commercial advisers.

"The college," he states, "has no right to run financial risks," yet as he reviews the financial status of our colleges, it is all too apparent that risks are often assumed with consequent losses. In spite of the wisest counsels, mistakes in investment are frequent. Men who have accumulated large fortunes and have been benefactors of their time by founding and endowing colleges, have been confronted by a new financial consideration, the permanence of investment.

Briefly, the investment of funds for a college presents an aspect differing greatly from the usual business procedure. The investment must be conservative and permanent, and not changed with fluctuating markets. Colleges are not able to carry large reserve funds, and severely feel the loss when any part of them becomes unproductive. Of the half-dozen or so great institutions founded in recent years for the promotion of higher culture and the technical study of the sciences, all, with one exception, have suffered more or less financial losses through depreciated investments. In some cases this has occurred through the mistaken judgment of the donors, who, with the conservative grasp of large wealth, have been unwilling to donate funds unreservedly to a constituted board of trustees, preferring rather to retain the investment in their own hands. Confronted by conditions and problems radically different from those encountered in the usual routine of business, it is not surprising that they have erred in judgment and that their institutions have suffered.

The failures of the endowments invested in two great railway systems have been conspicuous. At the time such investments were made, railway bonds were justly considered stable and satisfactory. But times have changed; competition and the retribution of dishonest financiering have brought disaster and railway holdings are no longer profitable.

The depreciation of real estate values, litigation in the settlement of estates, have each added their share to the general distress. Much of the distress of the afflicted institutions has never reached the public; only those in college circles know the severity of the ordeal.

The relation of these colleges to the public at large is generously appreciated. The rapid growth of our country in its material and intellectual development depends largely upon such institutions for its existence and increase. Probably it will not be disputed that the technical school is one of the most potent factors in the material progress of to-day. In this broad view, each college and technical school is a factor in national progress, and is only sectional in a restricted sense.

What shall be the remedy for the present depressed financial outlook of our institutions of learning? Whatever form the remedy assumes, one of its features is in guaranteed investment, so permanent in its nature that the donors of endowments shall be assured that their gifts will be safe, whatever the conditions of the railways and real estate markets, and that widespread panic conditions will not affect them. A college must be permanent before it can acquire the services of distinguished and able professors. It is essential that departmental incomes shall be so fixed and assured that plans for development may be far-reaching. It is a debt owed young men and women that the courses of study, covering often seven and eight years, shall not be broken in upon and curtailed by financial fluctuations of the funds.

The proper education of the youth of the country being a matter of such national concern, it would be only just, in spite of our well known aversion to paternalism, that the permanence needed be in some way assured by the general government. The obligation would be met by the issuance of some form of educational government bonds. Such bonds might be of the usual denominations, and bear interest of at least 4 per cent., the rate of interest to be perpetual. The bonds should be sold directly to the purchaser at face value, and be redeemable but not transferable. This may be regarded as equivalent to the purchase of a taxation support from the government, but if it be such, wherein is the objection to it? In practice a serious obstacle might arise from the extent of the application, all organized charities claiming the same permanent protection. But the wheels of progress have been too often stayed by such reasoning.

These bonds would doubtless result in a great increase in the endowments of the colleges. Many persons of limited means would prefer to leave moneys for such purposes could they be assured of the permanence of the bequest, and that the individual gift would not be quickly absorbed in the general fund for running expenses. Men who, all through their careers, have felt the lack of such training, would respond more generously. Various other advantages readily suggest themselves.

There may be some fear that such procedure would result in a gigantic protected monopoly for the colleges, and that they would become excessively wealthy. This is certainly not the present condition of affairs, for the aggregate value of the real estate and endowments of the colleges is a less sum than the aggregate investments in electrical street railways alone. It is further a question if institutions should not possess large incomes, so large, indeed, that education should incur no fees of any kind whatever.

Aside from the enormous expenses of equipment of laboratories and their maintenance, more, much more, money is needed for scholarships, to develop the promising men and women who throng our colleges, and save much of the priceless energy which is now so lavishly expended in the mere struggles for existence. If it be thought that some of our laboratories cost excessive sums of money, in contrast there is not a laboratory in this or any foreign country whose equipment has cost the sum yearly spent by many wealthy individuals in the maintenance of a summer home, or a magnificent yacht.

THE ELECTRICAL LABORATORY OF THE UNIVERSITY OF WISCONSIN.

RECOGNIZING a fully equipped laboratory as one of the essential features of technical training, the University of Wisconsin has been continually adding to the equipment of the electrical laboratory, and, in addition to appropriations made each year for the purpose, the collection of machines and electrical supplies has been materially increased by donations of various electrical manufacturers who find it to their interests to have their products represented.

The collection of dynamos and motors has been made with the view of obtaining a large variety of machines rather than large machines, with the purpose of enabling the student to become familiar with any type of dynamo or motor which he is likely to meet in practice. Among the machines installed are 12 direct current constant potential dynamos and motors of different types, ranging from 1 to 10 h. p. capacity, 4 railway motors, 3 arc machines of different types, alternating and direct current arc lamps, single and polyphase alternating current dynamos and alternating current motors of the three-phase, two-phase and self-starting synchronous types. Current from the monocyclic generator of the city lighting station is available for experimental work, as well as that from the 500 volt railway circuit. The various dynamos in the labo-

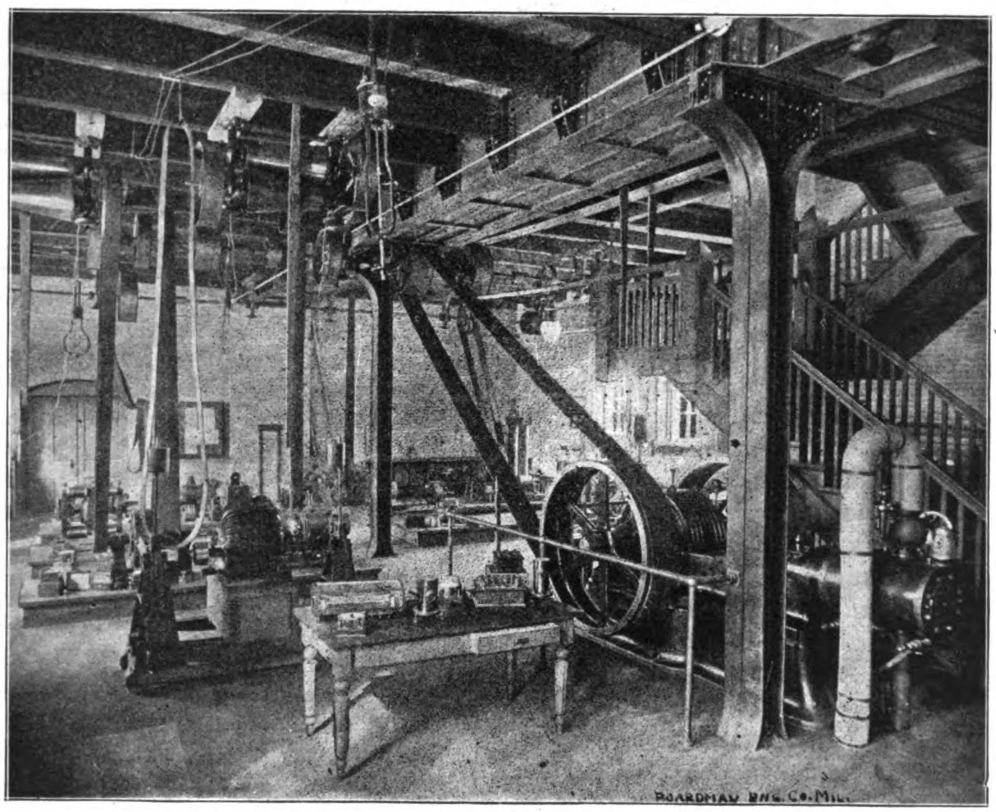
ratory are belted to overhead shafting and are run from a Weston engine, which regulates excellently for constant speed.

The bank of transformers represents the type of nearly every manufacturer in this country as well as that of several foreign makers. For measuring purposes, a number of wall ammeters and voltmeters are conveniently located, and the instrument shelves show portable ammeters, voltmeters and wattmeters of the Weston, Whitney and other types, a portable electrostatic voltmeter and a variety of other instruments which need not be enumerated. The recording wattmeters include a Thomson instrument for street car testing and a bank of recording wattmeters which are useful testing instruments, as well as offering an opportunity of studying their relative merits. The laboratory is well equipped for making measurements of the magnetic qualities of iron and steel, having a Ewing hysteresis curve tracer, a Ewing magnetic bridge and a Ewing hysteresis tester. A 1 h. p. 1,000 volt dynamo, together with galvanometers and accessories, serves for measuring the insulation resistance of wires, cables, etc.

A convenient method of absorbing power and of conveniently varying it at will is very necessary in such a laboratory, and after trying various liquid, iron and german silver rheostats, three lamp banks containing 100 incandescent lamps each, capable of absorbing 10 electrical h. p., were made, and are all that can be desired in the way of convenience. The fields and armatures of each machine, the wall instruments and the rheostats are connected by wires laid beneath the floor to a switchboard, enabling any combination of instruments and machines to be easily and quickly made.

A division of the electrical instruction which has recently been developed and for which suitable laboratory equipment has been installed, is that of electrochemistry and electrometallurgy. For the electro-deposition of metals, eight enameled iron tanks are used, with iron vats for hot water and lye, lead-lined tanks with running water, and grinding and polishing lathes for cleaning and polishing the metal surfaces. The current used for this work is supplied by a rotary transformer, transforming from 110 to 6 volts. Three electric furnaces of different types are used for experimental work with high temperatures and for the electrolysis of molten substances. The accompanying half-tone shows a portion of the dynamo laboratory, and the electrolytic laboratory is located on the second floor of the same building.

The experimental work in the laboratory is planned with the view of acquainting the student with the various types of electrical apparatus, use of electrical instruments, and special attention is given to familiarizing him with the most approved methods of commercial testing which are frequently used in practice.



DYNAMO LABORATORY, UNIVERSITY OF WISCONSIN.

ROENTGEN RAYS

MAGNETIC DEFLECTION OF CATHODE RAYS.

If the lines of force of a uniform magnetic field are at right angles to the rectilinear path of cathode rays, the rays are deflected in such a manner that their path assumes the shape of a circular arc, whose plane is normal to the direction of the lines of force. The extent of the deflection depends upon the field, and also upon a variety of other conditions, such as the degree of exhaustion, the chemical nature of the gas, the dimensions of the tube and the presence or absence of spark gaps. W. Kaufmann, in "Wiedemann's Annalen," claims to have proved that all these conditions are simply secondary, and may be reduced to the influence of the discharge potential between anode and cathode. He also proves that the deflection is inversely proportional to the square root of the difference of potential between the electrodes. The cathode rays were generated in a wide cylinder provided with a narrower tube containing the cathode at the end and the anode at the junction with the cylinder. Thus the shadow of the anode was thrown upon the other end of the cylinder, which consisted of plate glass with a thin layer of fluorescent chalk. The cylinder was surrounded by a coil of wire wound on a zinc cylinder, which produced a uniform field at right angles to the cathode rays. Separate series of measurements were made to determine the influence of the material of the cathode, the distance between the electrodes, the nature of the gas and the presence of spark gaps. In every case the curvature of the rays, divided by the square root of the difference of potential, was found to be constant within 1 per cent.

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ELECTRICAL MACHINERY AND LABOR.

NO one who follows the course of events in the applications of electrical machinery and apparatus of all kinds can fail to recognize the important position which these appliances have already assumed in the economy of civilized communities and the still greater importance to which they are destined in the future. As many electrical appliances may be classed under what is known as labor-saving machinery, it seems opportune to inquire as to the probable effect of the increasing adoption of such machinery, upon the status of the so-called laboring man, or, better, the "wage-earner." In the light of the experience of the past one hundred years such an inquiry might appear to be unnecessary but when so representative a man as Bishop Potter of New York, as he recently did, lays at the door of the labor-saving device many of the bad social conditions and much of the discontent of the masses, it seems indeed worth while to cast a glance at the state of affairs. What, as a matter of fact, has been the effect upon labor, so called, of the labor-saving machine? For answer we must look to reliable statistics, and these are afforded in a brief, but admirable review of the question contained in the August Chautauquan, by the pen of the Hon. Carroll D. Wright, U. S. Commissioner of Labor. As a statistical analyst, Mr. Wright will be conceded to rank without a superior in the United States and the figures he brings to bear upon the subject prove conclusively, not only that labor-saving machinery does not deprive men of labor, but that it broadens the fields of their activity to a marked degree. Look in whatever direction we will, it is found that wherever machinery has gained its highest development, and greatest employment, there also are the greatest number of men at work. This statement alone, as Mr. Wright says truly, ought to be sufficient to answer society that the introduction of machinery has not deprived men of labor. Among the many specific examples cited by Mr. Wright, those relating to electrical branches will appeal particularly to our readers. Thus it is shown that thousands and thousands of people are employed in telegraphy where not a single individual has been displaced. These thousands find remunerative employment in the construction of telegraph lines, the manufacture of telegraph instruments, the operation of lines, etc. The telephone has added to this vast accumulation, while who can estimate the numbers that have been directly benefited since the introduction of the dynamo, the electric motor, the electric light and the electric car. Perhaps as good an example of the lesson he seeks to convey, and as good a contradiction to the common belief—if it really be common—as could be well found, is the experience cited by Mr. Wright during a visit to Minneapolis and St. Paul a couple of years ago. The electric line between these twin cities, by the superior facilities offered by it, caused the suspension of the steam road which had theretofore been in operation. Having been informed by a fellow-passenger, a mechanic, that the brakemen and other train hands of the old steam road had been thrown out of employment, he questioned his informant more closely and finally elicited the information that only six or eight people were practically injured by the new order of things, while it took eight or ten times the number of men to run the frequent electric cars. But what is more, a low grade man, says Mr. Wright, cannot run an electric car; he must have intelligence enough to understand and comprehend the methods necessary for the propulsion of the cars, and as an intelligent being he is vastly superior to the man required to drive the horses of an ordinary horse street car. So much for those who look upon machinery as soul-deadening and intellect-killing devices. Mr. Wright also proves conclusively that with the greater skill required to handle machinery come higher wages, and shorter working hours. He mig..t have gone further but he has brought enough facts to bear to disprove absolutely that lingering barbarism and misguided opinion that caused the mob of spinners to destroy Hargreave's newly-invented jenny. We have probably not heard the last of such folly, but the philosophy of history is so strong in its indications that error can now be little else than wilful.

WHERE THE TELEPHONE COMES IN.

ONE of the peculiar features of the telephone is that it takes intelligent people so long to find out the ease with which they can accomplish the purposes of business and pleasure when they resort to its use. To be bedridden is popularly supposed to be the height of seclusion and deprivation, but with the telephone the invalid and valetudinarian become the people who can enjoy more things that are going on than anybody else. It looks as though the bicycle had arrived just in time to preserve in pristine vigor and symmetry the legs of the human family; for the telegraph and telephone, supplemented by the horseless vehicle and the "thunderbolt express," had threatened to render legs as superfluous as the atrophied tail. The ability of the ubiquitous telephone is little short of supernatural. Down in Kansas, at Wichita, Superintendent W. E. Stanley, with a broken thigh, and, therefore, unable to leave his bed, has been telephonically conducting the largest Sunday-school in a State whose very heresies are Brobdignagian. Mr. Stanley, lying on his back, talked to the school, gave out the hymns, delivered a little address, listened to the singing, and expressed his delight; while in the evening the performance was reversed, and he took in the sermon of the Rev. Dr. Slutz. The injunction of the Great Healer, "Take up thy bed and walk" is abundantly amplified in the modern version of science, "Lie in thy bed and talk." Curiously enough from Kansas, where just now, happy to relate, they are learn-

ing a good many things they did not know last year, comes the statement that at Fort Scott, "for the first time," testimony has been received by telephone, in a case where two witnesses were absent. It is to be hoped that this practice, new to Kansas, but not new to other parts of the country, will spread and grow, and that juries as well as witnesses can be spared the tedium and annoyance of attendance in court. If there is one hollow sham and wretched nuisance to-day, it is that of giving and hearing evidence in the law court, and every honorable, sensible man abhors the whole proceeding. With the telephone, however, we can change all that. Just what can be done in this direction was indicated in New York the other day, under circumstances which deserve to be given with a little minuteness. The sheriff had received an attachment for $2,200 against George P. Altenburg, banker and broker, at Cincinnati, Ohio, in favor of Frank A. Rothier, and a deputy sheriff had levied upon money in the hands of Purnell, Hageman & Co., bankers. The attachment was obtained only by taking an affidavit of the plaintiff over the long distance telephone direct to Cincinnati. The suit was brought to recover money deposited by the plaintiff with the defendant, individually, to invest for him in Western Union and other shares. He alleged that Altenburg did not invest the money given him, and refused, when asked, to return it. As Rothier desired to attach property in New York City belonging to Altenburg, it was necessary for him to make an affidavit that the facts, as alleged, were true. His counsel, Horace E. Deming, was anxious to act upon the attachment at once, but was puzzled how to do so. when Joseph G. Dean, of counsel for the plaintiff, suggested that they should take his affidavit by telephone. This was agreed to, but another difficulty then arose. Neither of the lawyers here knew Rothier's voice, and were aware that without being able to prove that the plaintiff was the person making affidavit over the wire, the attachment could not be obtained. Mr. Dean knew a gentleman in Cincinnati named A. K. Stello. The latter was called to the telephone and requested to bring Rothier to the sender. Mr. Dean stated that he recognized Stello's voice, and next spoke to Rothier, whom Stello identified as Frank A. Rothier. This man proceeded to make the necessary affidavit, but when it was concluded, another puzzle confronted Mr. Dean. It was how to have the affidavit signed and sworn to before a New York notary public. Mr. Dean administered the oath usual in such cases to Rothier, and then affixed his name to the affidavit, stating it was sworn before him. Stello made an affidavit swearing to Rothier's identity, and Mr. Dean made a third affidavit setting out all the facts as to the proceeding. Upon this testimony the attachment on which the levy was made was granted. If this splendid illustration of the way in which the law's delays can be abbreviated and circumvented, by the telephone, does not have some effect, we shall be greatly in error and sadly disappointed.

MAXIM'S NEW INCANDESCENT LAMP.

A CABLE dispatch to the New York "Journal" last week announced that Mr. H. S. Maxim had invented "the finest, cheapest and strongest electric light ever made, with nearly three times the candle-power of the ordinary incandescent light." We are also informed that it lasts more than twice as long as, and requires less than half the energy of, the present type of incandescent lamp. We will not go into the details of the economy of the lamp as given in the dispatch, as they are somewhat mixed, and we would not care to hold Mr. Maxim responsible for the vagaries of the newspaper correspondent. But what is most important is the fact that the new Maxim lamp is said to have a mineral filament. Although the name of the mineral is not given, it is safe to infer that the substance is derived from some of the rare earths containing zirconium, caesium and their related elements. Lamps of this type have been made in the past, but have not come into general use for various reasons, principal among which is their high cost. We are informed that Mr. Maxim's new mineral filament costs 1 cent. While this figure is relatively considerably higher than the cost of a carbon filament, it would by no means be prohibitory, if the new lamp answered other practical requirements of efficiency and life. As to the former point, we believe that tests have shown decided economy, but we know of no authentic life tests on this type of lamp. The carbon filament has held its own remarkably well during the ceaseless struggles for a better filament, but that is no reason why one should give up hope of ever beating it. The Welsbach mantle, a mineral filament, as it were, has certainly given gas a decided impetus, and there is no reason why electrical engineers should not call the rare earths to their aid to put the electric incandescent lamp still further above competition. Mr. Maxim's lamp will bear watching. At least, there is nothing chimerical about it.

GOVERNMENT TELEGRAPHS AND OTHER THINGS.

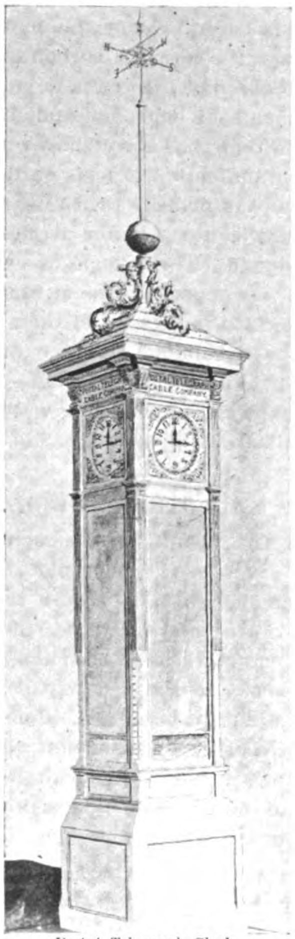
JUST at a time when the New Orleans "Times-Democrat" is extolling the beauties of government telegraphs, the operators in England are "kicking like steers" because they are dissatisfied with the state of things; and in France there is a scandal because the government wires have been tapped to sell news for the London "Times" to Paris newspapers. These unhappy coincidences should not be permitted. Consul Monaghan, at Chemnitz, Germany, has sent to the State Department a report which, speaking of the government railroads, says: "No other branch of public property pays so surely and well. . . . Their quasi-public character has helped the people to understand that they should be controlled at least, if not owned, by the State." At this very juncture appears a letter in the "Evening Post," which, in speaking of unfavorable conditions in Germany, says that among the causes responsible for the unsound condition of agriculture in the eastern half of Germany "the unreasonably high freight rates charged by the railroads, owned by the State, mind you, are among the most important. These freight rates are so high that they double, treble and even quadruple the original prices." The letter goes on to explain why this country is thus able to flood Germany with apples, and why the inland Germans get so little sea fish and shell fish, even when the salt water is only fifty miles away. Mr. Monaghan had better study his theme deeper or come home.

PRICES GOING UP.

SO many articles of everyday use are now advancing in price, it is only reasonable to expect that electrical materials and apparatus will soon fall in line. Some of the quotations on electrical goods, such as wire, dynamos, motors, are little short of absurd, and, as we said the other day, there must be a change. The competition that has existed for some time past in the endeavor to find some lower depth yet for prices, has now got to cease very soon. It may be questioned whether so large an amount of material, for example, has ever been sold on so minute a margin of profit, as has been seen in the case of electrical wire during the last two years. Nobody has benefited in the slightest degree, not even the purchasers, and they should be among the first to enjoy good results from a return to the normal conditions of cost and profit.

TELEPHONY AND TELEGRAPHY

THE POSTAL TELEGRAPH CLOCK.


Postal Telegraph Clock.

A VERY ingenious and useful innovation in the direction of furnishing the public with the correct time, free of cost, has been made by the U. S. Time and Weather Service Co. of this city. The idea involved in the plan is to set up in different and prominent places in each city a number of tall, handsome clocks, which shall give exact United States time, and which drop a ball at high noon. This scheme has been successfully worked out in connection with the Postal Telegraph Cable Company, over whose wires the time service is sent and whose name is placed conspicuously on each clock. A large number of these clocks have already been set up in the West, the number in use by January will be between 100 and 200, and the Postal Building in Broadway is to have one placed before it immediately. Mr. F. E. Sutton, the secretary and treasurer of the Time Company, tells us that the service is proving very popular, and that "Postal time" is already a standard, well known phrase in many a Western city.

We illustrate the clock herewith. It stands about 18 feet high, all told, and the gilt ball, 10 inches in diameter, under the weather vane is dropped three feet at noon exactly each day by the usual method of time signaling. Over the clock dials is the name of the Postal Company. Under the clocks are large panels, about 18 inches by 63, which are filled up with local and special advertising. Beneath these are smaller panels which give each morning the latest United States weather reports, two or three hours before they appear in the afternoon papers. At the corners of the stand on the street side are a thermometer and a barometer. The clock stands are made of cast iron, bolted securely to the sidewalk paving, and are handsomely painted white and gold, or sage green, etc., as may be desired. Ordinarily the streets on which the clocks are placed are well enough lit to enable the time to be read easily without extra light, but arrangements have also been made, when necessary, to illuminate by electricity the clock faces and also the advertising panels. So pleasing is the general effect of these clocks, they have already been ordered to be placed in front of several city halls. The United States Time Company has organized three or four sub companies to take care of the business in different sections of the country.

THE BEAUTIES OF GOVERNMENT TELEGRAPHY.

Even if the reports from densely populated European countries like England and Germany should prove as favorable as 'could be desired, they would afford little argument for the establishment of a Government telegraph system in this country under vastly different conditions. But apart from the enormous burden of such an attachment to the Government machine, there are other considerations which might well give pause to the most enthusiastic advocate of Paternalism. Take one example of the practical operation of the system: Fourth of July last fell on Sunday, as is the case frequently in a series of years. In some places the postoffices were closed, in observance of the holiday, on Saturday, July 3, and in others on Monday, July 5. As a consequence, there was a serious interruption of mail communication for three days of the week. But, fortunately, the private telegraph offices were open on all three days, and thus afforded much relief to business in the postal blockade.

Let the Government seize the monopoly of the telegraph, and the telegraph offices, like the postoffices, would be closed on every holiday. It need not be urged that the Government telegraph monopoly and the private telegraph companies cannot exist, here or in any country, side by side. In lowering the rate for telegrams (which appears to be the great desideratum with the champions of this scheme of Paternalism) the Government would make up the deficit out of the Federal Treasury, as is the case with the enormous and constantly growing postoffice deficit. But the private telegraph companies, having no such resource, must depend upon their earnings; and in competition with the Government machine they would soon be driven to the wall. The establishment of a Government monopoly would amount to the destruction of the capital invested by private telegraph companies. Whether a Government of equity can perform such an act toward its citizens is a question of public morality.

Under the Government postoffice system, which excites so much admiration on the part of the votaries of Paternalism, there is no responsibility for the loss of missives carried by mail. The kindly Paternal Government will register your letters, and if the money contents shall be rifled by one of its agents you may whistle for your loss. Express companies and all other common carriers guarantee the safe delivery of all articles entrusted to their care; Paternal Government alone is exempt from such obligation. Private telegraph companies are responsible for any loss or injury caused by the neglect of their agents in transmitting dispatches; under the Government telegraph monopoly the responsibility would cease. It may be said that the Government could make provision for making good all losses caused by its telegraph agents, but sad experience has taught the difference between the settlement of a claim for damages against a private company and the fate of a claim against the Government.—Philadelphia Record.

LITERATURE

L'ECLAIRAGE A L'ACETYLENE.—(Lighting by Acetylene.) By G. Pellissier. Geo. Carre & C. Naud, Paris, 1897. 238 pp. 5½ x 8½ in. 102 illustrations. Felixble cover. Price, $1.50.

The author has sought to present as favorable an exposé as possible, of the actual state of the acetylene industry, devoting particular attention on the points of general interest, such as the possible dangers, the conditions to be fulfilled in the rational preparation and utilization of acetylene, etc. The subject is introduced by a brief description of the various electric furnaces which have been proposed and constructed for the production of calcium carbide, from which acetylene is produced. The preparation of acetylene for its commercial utilization occupies several chapters, containing descriptions of a variety of generators, some of which are of considerable ingenuity. The part devoted to the dangers of acetylene will make interesting reading to the advocates of electric lighting. We also notice a description of various types of acetylene burners. M. Pellissier has a very happy style of expression, and the book is interesting as well as instructive.

VORLESUNGEN UBER DIE ELECTRO-MAGNETISCHE THEORIE DES LICHTES. (Lectures on the Electro-Magnetic Theory of Light.) By H. von Helmholtz. Edited by Arthur Koenig and Carl Runge. Leipzig, 1897. Leopold Voss. 370 pp., 6½ x 10 in. 54 illus. Paper. Price, $2.50.

The present volume of the lectures of the late H. von Helmholtz is the fifth of the series of his lectures on Theoretical Physics, and is published from the stenographic notes of Dr. Borchardt, taken in the winter semester of 1892-93, and in its greater part has been personally revised by the late Helmholtz. It gives the theory of light in its completed form, exemplified by formulas and equations, together with a historical review of the theory of emission and undulation.

MISCELLANEOUS

ON SOME NEW FORMS OF GAS BATTERIES AND A NEW CARBON CONSUMING BATTERY.[1]

BY WILLARD E. CASE.

IN 1839, Grove announced his discovery of the gas battery, considering it the most simple arrangement to produce electricity. He never considered it a practical way to generate electrical energy. Grove used platinum sponge or platinum black as the absorbent to facilitate the combination of the gases. The following experimental determinations by the author will show, as far as they extend, that platinum or its compounds are not necessary to produce the combination of the gases in the production of electrical energy, so doing away with one of the most expensive drawbacks to the gas battery. The experiments also prove that carbon is oxidized to CO_2 at normal temperature without the application of heat, with the production of electrical energy.

In these experiments, it will be noted that platinum is not essential to the reactions. Both electrodes in each case can be carbon tubes or plates. The physical condition of the carbon in its many forms plays a most important part.

The Chlorine-Carbon Cell.—A porous carbon-tube electrode, into which chlorine gas was passed, opposed to a carbon rod, which had been heated red hot, was placed in hydrochloric acid, of specific gravity 1.10. An e. m. f. of from 0.50 to 0.54 volt was obtained, depending on the condition of the carbons.

The carbon electrodes, after being heated, were again assembled and placed in distilled water. With no gas passing through, they gave an e, m. f. of 0. When the chlorine gas was passed into the carbon tube, at slightly above atmospheric pressure, the e. m. f. gradually increased to 0.44 volt at the end of twenty-six hours. On short circuit, 0.04 ampere was obtained, but it dropped rapidly to 0.02. The internal resistance was very high. The electrodes were taken out and the solution analyzed. It was found to contain hydrochloric acid and carbon dioxide. The same experiment was repeated in a dark case, to see if the action took place in the absence of light. The chlorine gas was made in the dark and passed through the electrode. The electromotive force gradually increased, as in the first case, showing that the action took place in the dark.

A carbon electrode, through which chlorine was passed, and a negative platinum electrode opposed to it, in dilute hydrochloric acid, gave 0.4 volt, but the electromotive force did not hold up through the voltmeter circuit. Both electrodes were covered with gas after short circuiting, and the e. m. f. dropped to 0.24 volt. On shaking, the voltage jumped to 0.4.

A negative carbon electrode was substituted for the negative platinum. It had been heated red hot and was very porous, the surface soft and rough. The e. m. f. reached 0.58 volt, and gave on short circuit 1.24 amperes, but dropped slowly to 0.3. The negative carbon electrode was oxidized.

A platinum electrode in a paper envelope, opposed to powdered carbon in the bottom of a glass jar in hydrochloric acid, chlorine being passed into the solution near the platinum. An e. m. f. of 0.60 volt, and on short circuit 0.9 ampere, were obtained. The current remained fairly steady. The surface of each electrode was about 45 square inches.

A cell made up as above, but with graphite instead of carbon, gave 0.54 volt, but dropped rapidly on short circuit, the graphite not oxidizing fast enough to give a steady current. A dense carbon rod opposed to powdered carbon gave 0.4 volt and on short circuit 0.2 ampere. The rod was encased in filter paper to protect it from floating particles of powdered carbon, and the chlorine passed into the solution near it.

Two small glass beakers connected by an inverted U-tube and containing hydrochloric acid, with a carbon rod in one and platinum plate in the other. When chlorine was passed into the vessel with the platinum, an e. m. f. of 0.48 volt was obtained. When chlorine was passed into the beaker containing the carbon rod, an e. m. f. of 0.14 was obtained, but it dropped almost immediately to zero. When chlorine was passed into both beakers, no e. m. f. was obtained.

The chemical reaction of the chlorine-carbon cell was as follows: $H_2O + Cl_2 = 2HCl + O$, the oxygen of the decomposed water attacking the carbon, and hydrochloric acid and carbon dioxide being formed.

[1]Read before the British Association, Toronto.

Carbon Monoxide-Chlorine Cell.—Cell made as follows: A glass tube, 2.25-inch bore and 6 inches long, corked at each end, with a porous tube, 1 inch outside diameter, passing through the glass tube and corks, and corked at each end, carbon rods and gas inlet and outlet tubes let into each chamber, which were filled with dry animal charcoal previously treated with hydrochloric acid. The porous tube was saturated with concentrated hydrochloric acid. Chlorine gas was passed through the outer tube. An e. m. f. of 0.18 volt was obtained. Then carbon monoxide gas was passed through the inner tube, and the voltage increased to 0.33 volt. A slight increase of the pressure of the gases increased the voltage. The glass tube became hot. This reaction would produce carbon oxychloride.

Marsh Gas-Chlorine Cell.—Two carbon tube electrodes, ¾ inches in diameter and 4 inches long, opposed to one another in a solution of hydrochloric acid, with chlorine passed into one and marsh gas into the other, gave an e. m. f. of between 0.6 and 0.7 volt, varying with the condition of the carbon. A current of 0.7 ampere was obtained on short circuit, but the cell rapidly polarized. Afterward, fresh carbon electrodes, with the gases passing through them, were placed in distilled water, and the e. m. f. gradually increased from zero to 0.14 in twelve hours. On testing the solution, hydrochloric acid and carbon dioxide were found to be present. The chemical reaction of this cell is as follows:

$$CH_4 + 4Cl_2 + 2H_2O = CO_2 + 8HCl.$$

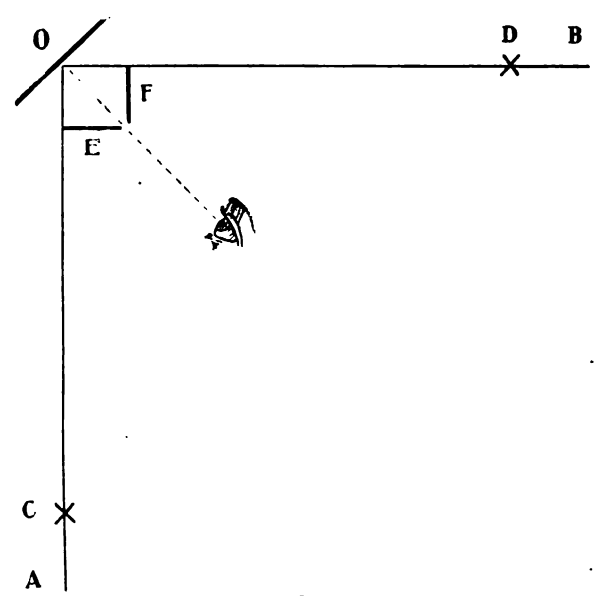
The calculated e. m. f. of this cell is 0.65 volt.

In making these determinations of electromotive force and current, a Weston direct reading voltmeter and mil-ammeter were used. Resistance of voltmeter, 352 ohms, reading from 0.01 to 3 volts. The ammeter read from 0.01 to 2.00 amperes. In all the experiments, the gases used were but slightly above atmospheric pressure. Owing to limited time, the author is not able to furnish further data. Experiments to determine the many interesting questions involved are being conducted.

Mr. C. E. Timmerman, of Cornell University, who has assisted me, has taken great care, with the limited time at our disposal, to verify these results.

PROF. S. P. THOMPSON'S NEW PHOTOMETER.

AT the Friday meeting of Section "A" of the British Ass'n, Prof. Silvanus P. Thompson described an ingenious and simple form of photometer, the main advantage of which is that it occupies less space than the usual forms in which the bench is quite straight. The new photometer bench consists of two parts, OA and OB, the joint O being conveniently placed in one corner of a small room, and the lights to be compared are placed at C and D. At O a flat disk or plate of white blotting paper is placed, screens at E and F serving to permit of one-half of the blotting paper being illuminated



THOMPSON PHOTOMETER.

by each source of light respectively. According to the well-known cosine law, if OD and OC are equal, and if the white screen be rotated until illuminated equally by the two sources of light on its two halves respectively, the intensities of the lights will be proportional to the tangent of the angle which

the blotting paper screen makes with one axis of the photometer bar. The material of the white screen must be destitute of specular reflection, and white blotting paper of not too smooth a surface has been found to be the most suitable.

ON THE FUEL SUPPLY AND AIR SUPPLY OF THE WORLD.[1]

BY LORD KELVIN.

LORD KELVIN commenced by sketching briefly the origin of fuel on the earth. He stated that the source of fuel is ancient vegetation, and classifies animal fuel also as vegetation, as all animals primarily feed on vegetable diet. He stated that probably no fuel existed on earth prior to the commencement of life on this planet, which he placed at less than 20,000,000 years ago. As a standard fuel he took one which required three times its weight of oxygen to consume it, and estimating the total amount of oxygen in the atmosphere he thus arrived at an estimate of the maximum possible amount of fuel in the planet. He neglected, however, the oxygen in the waters and solid matter of the earth. The total oxygen thus amounted to 1,020,000,000,000 tons, from which the weight of fuel was estimated to be not more than 340,000,000,000 tons.

After briefly sketching the process of solidification of the molten earth and the crystalization of primary rock, Lord Kelvin made some comments on the fuel supply of Great Britain, which he stated was greater than could possibly be burned by the total amount of oxygen in the air lying immediately over the British Islands. The effect of sunlight in storing energy and fuel was next reviewed, and the interesting statement made that two tons of vegetation per square meter per thousand years is about the average power of sunlight, whether in German forests or in English hay fields.

THE SPECIFIC HEAT OF SUPERHEATED STEAM.[1]

BY PROFS. EWING, F. R. S., AND STANLEY DUNKERLEY.

IN these researches the mean specific heat of superheated steam between the saturation temperature and a few degrees above saturation was measured by throttling dry saturated steam at a pressure above the atmosphere through a porous plug down to atmospheric pressure, and observing the differences of temperature and of pressure on the two sides of the plug. The plug consisted of rolled silk, and the steam passed through it at sufficiently slow rate to obviate any errors arising from the velocity of the steam. The extraordinary result was obtained that the specific heat of superheated steam is lower for temperatures near the temperature of saturation than for temperatures considerably above the saturation point, a result which appears at first sight to be contrary to the usual conception of the properties of steam just beyond the saturation point. These researches have not yet been completed and the value of the specific heat has not yet been absolutely determined. It is intended to pursue the investigation in regard to steam throttled down to pressures higher than that of the atmosphere.

THE ELECTRICAL DETERMINATION OF SPECIFIC HEAT.[1]

BY PROFS. H. L. CALLENDER, F. R. S., AND H. T. BARNES.

THE paper described a new method of determining the specific heat of a liquid in terms of the International Electrical Units. The researches were the outcome of the circular issued at the Liverpool meeting of the British Association last year, in which a method of evaluating the unit of heat was specified. The method adopted by the authors is an electrical one and consists in balancing the heat generated by a current against the heat carried away by a steady stream of liquid. The method has the advantage that all the conditions are steady. The electrical measurements were made with a Thomson-Varley slide box, and the temperature measurement by means of two platinum thermometers. In order to minimize the loss of heat by radiation a vacuum jacket surrounded the apparatus in which the heat was generated. The main object of the research was to find the variation of specific heat with temperature, but this part of the work has not yet been completed. The paper is accompanied by the following table:

Specific Heat of Mercury.

Rise of temperature = $d\theta$.	Liquid flow = Q.	$= 0.1600\,Q\,d\theta$.	Watts = EC.	Diff. = EC—$0.1400\,Qd\theta$
12°.301	4.594	7.912	8.488	0.576
11°.872	6.740	11.202	11.696	0.494
11°.764	8.753	14.418	14.862	0.444

The value of the sp. ht. of mercury at 28° C. was found to be 0.13905.

[1]Abstract of a paper read before Section "A" of the British Association at Toronto.

PROTECTION AGAINST LIGHTNING.

BY PHILIP ATKINSON.

THE dense ignorance, prejudice and misapprehension which prevails in regard to lightning rods, even among well informed electrical people, are responsible for most of the loss of life and damage to property caused by lightning. In nearly every electric storm, whether in the city or country, buildings are struck and often burned, and people hurt or killed. The cases of this kind reported in the daily papers show that, in the aggregate, this loss of life and property is enormous; and yet people, with ample and efficient means of protection at hand, submit to it, as something inevitable, the general impression prevailing that the lightning rod affords no protection, but is rather an additional source of danger.

An instance of this came under my observation recently. A friend consulted me in regard to the erection of a lightning rod on his house; and after giving him full and explicit instructions as to its construction, I sent him to a man whose specialty was wiring buildings, for information in regard to the nature of the copper which I recommended. This man, as I afterward learned, had certain antiquated notions in regard to lightning and lightning rods, and instead of giving the desired information, expatiated on the terrible risk and danger which would be incurred by erecting the rod, and so frightened my friend that he abandoned the project.

It is undoubtedly true that a badly constructed rod may be very dangerous, and worse than none; and that such rods are often erected by ignorant and unscrupulous men. But it is equally true that a good rod, properly erected, affords ample protection, and that such rods are exceedingly simple in construction, and can be obtained at very small cost.

Copper, in the form of ribbon, or tape, is the best and most convenient conductor for attachment to the house, as it lies close to the surface, fits snugly around cornices and other inequalities, does not mar architectural beauty by conspicuity, and is easily put up. But it must be soldered to an upright copper rod, extending 6 or 8 feet above the highest part of the roof, and terminating in one or more points; the lower end extending down to permanently moist earth, or a mass of iron.

If such ribbon is not easily obtained, the next best thing is copper rod, or wire, not less than No. 000 size, which can easily be had of sufficient length to extend from top to bottom without joints, which are always undesirable, and it can easily be bent into the proper shape to fit inequalities of surface.

The conductor, whether of ribbon or rod, should not be less in weight than six ounces to the foot, and should be attached to the building by straps of copper or galvanized iron, so as to be electrically connected with every part of it, especially with pipes, troughs and other metal parts, and not insulated from them, as is often erroneously done.

No better rule in regard to the height and number of the terminals projecting above the building, has been found than the old one, that the rod is supposed to protect a cone-shaped space whose base is twice the diameter of the height of the rod.

In these days when copper rod, or wire, of any size and of the best quality is cheap and abundant, there is no excuse for leaving a building exposed to lightning. Any one accustomed to wiring can easily construct and erect such a rod as here described at less than one-third the price usually asked by lightning rod peddlers for a rod which may be worse than worthless. The main terminal point can be made on the rod itself with a file, and a cluster of smaller points below it, by drilling two holes at right angles to each other, inserting cross-wires, which can then be soldered in place, turned up, and sharpened with the file.

With your house properly protected in this way, you and your family can go to sleep with a feeling of perfect security while the lightning flashes and the thunder crashes in close proximity above you.

On our modern high office buildings of steel and terra cotta it would doubtless be quite sufficient to extend copper termi-

nals from the top of the building and connect them with the mass of steel which forms the frame; as a charge of lightning, no matter how heavy, would distribute itself through this mass of steel, and pass off into the earth without damage, or any perceptible effect whatever; while, in the absence of such protection, it is liable to damage the non-conducting terra cotta and firebrick in which the steel is enclosed, or, perhaps, kill or maim the occupants. It is not long since one of the high office buildings in Chicago was struck by lightning and one of the ornamental turrets damaged.

RELATIVE ECONOMY OF WELSBACH LIGHTS.

BY G. I. K.

IN looking over The Electrical Engineer of June 23, 1897, I noticed an article on the subject of "Welsbach and Fuel Gas." As far as the fuel gas question was mentioned, I believe that the writer took the correct view, but as to the comparison between the Welsbachs and the incandescent electric lights, the statements in the above article are apt to be misleading.

I refer in particular to the report of G. W. Baird, U. S. N. It would appear from this report and comparison that this gentleman has not had any extended or practical experience with Welsbachs, as his deductions (as briefly summarized) in the matter are not substantiated by the experience of others, at least with the Improved Welsbach Light.

The basis of 3.2 watts per candle-power is seldom accomplished in actual practice, but assuming this as a comparative standard, we will look to the gas side of the question. 3,200 candle-power hours per thousand feet of gas means "sixteen candle" gas. This is not a fair rating, as the average candle-power of gas as now generally supplied is nearer 22 candle-power. This would make 4,400 candle-power hours per thousand feet, instead of 3,200.

Now take this thousand feet of gas and use a Welsbach light and the result is that we get fully sixty candles per burner (photometric test) and consuming not to exceed three feet per hour. This equals 20,000 candle-power hours per thousand feet, as against 11,200 candle-power hours of the electric incandescent, on the "dollar basis." In the matter of renewals, my own experience and what I have been able to learn from sources where the lights are used extensively, it has been found that the average of one mantle and chimney per 3,000 feet of gas consumed is practically correct. This is based upon their use for interior lighting, both commercial and residence. This makes the cost of renewals about one cent per 1,000 candle-power hours.

With the average life of the electric incandescent light, if the same is burned to its approximate candle-power, the cost of renewals (at 20 cents per 16 candle-power lamp) would be about one cent per 500 candle-power hours.

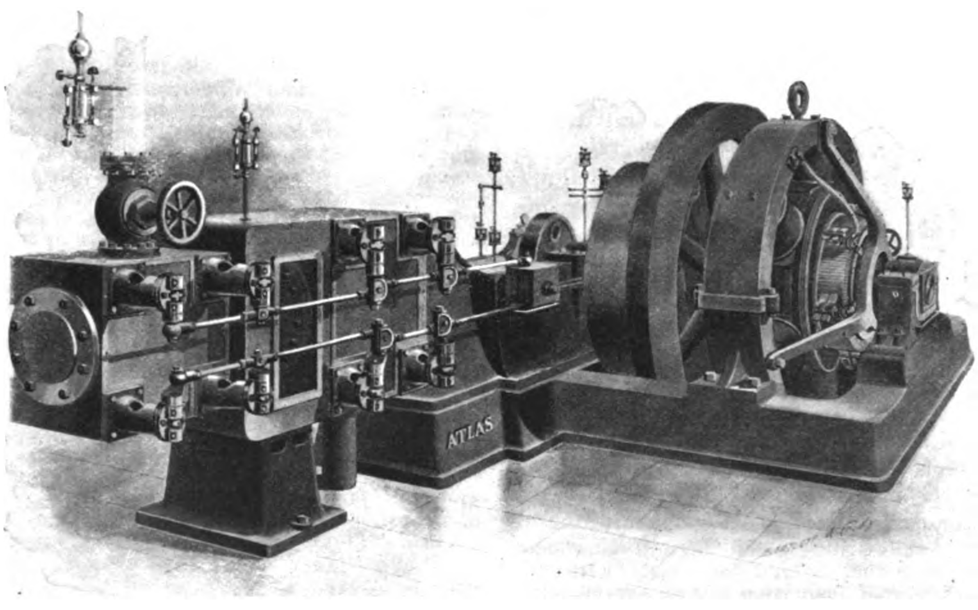
As to the gas companies looking upon Welsbachs with disfavor, it seems a short sighted policy, as anything that improves or cheapens a lighting service either in gas or electricity will ultimately result in a larger and better business for the manufacturer. Neither gas or electrical companies can afford to use or advocate obsolete apparatus or methods, and as the manufacture and distribution of "light, heat and power" in these two lines are becoming more closely allied, and the field of each more clearly defined, there is less ground for controversy, and the success and advancement of either branch will develop a greater field for both.

ATLAS CYCLOIDAL ENGINE IN ELECTRICAL WORK.

THE Cycloidal heavy duty engine, illustrated by half-tone cut on this page, was designed to meet the demand for a moderately high speed engine, which can be directly coupled to electric generators and operated with high steam economy. The showing which this engine has already made for itself is very satisfactory and has commanded the attention of steam and electrical engineers. Careful tests are said to have shown it to be more economical than the Corliss type of engine, and without having the restriction of comparatively slow speeds imperative with the familiar Corliss style of releasing valve gear.

The general appearance of a tandem-compound direct coupled unit is shown by the cut. The engine is designed for the heaviest kind of duty; the bed plate is very massive, and has removable, adjustable main bearings. All bearings, pins and wearing surfaces are very large and carefully finished; cylinders are steam-jacketed, and fitted with two admission and two exhaust valves, all of the multiported gridiron type, having flat wearing surfaces and removable seats. Admission and exhaust valves are separately operated, the admission valves being closed by direct steam pressure. Steam ports are very short and direct, and the steam clearance is reduced to a minimum. This valve gear is capable of very close adjustment, the valves are quick opening and closing, with very short travel, and give a long range cut-off. The engine is fitted with the latest improved oiling devices, and can be thoroughly lubricated while under continuous running at full speed. The governor is of the inertia type, is mounted on main shaft and gives extremely close regulation. The engine can be furnished either simple or compound, direct coupled to generator, or direct belted if desired.

The Atlas Engine Works, of Indianapolis, are the designers and builders of this engine. They have a special department with the best methods and appliances for the manufacture of high grade engines. This company has also recently brought out the Improved Atlas-Corliss engine, which we shall hope



THE ATLAS CYCLOIDAL ENGINE.

to have an opportunity to present to our readers with descriptive matter and cuts in a future issue. To Mr. A. M. Morse, manager Chicago office, 1108-9 Marquette Building, we are indebted for the above data, and may add that he will be glad to furnish further information to parties interested.

POWER FROM THE NIAGARA RIVER AT BUFFALO.

APPLICATION has been made to the War Department for permission to Sylvester N. Stewart, inventor, and J. C. Graves, trustee, to use the current of the Niagara River near the east shore and between a point opposite Fort Porter and a point 500 feet south of Ferry street, Buffalo, for the development of power where the same will not obstruct navigation, and this statement has been filed with the application:

"The city (Buffalo) has for a long time been desirous of utilizing the current of Niagara River for the generation of power for commercial purposes. At one time there was offered a reward of $100,000 for any apparatus that would accomplish the purpose. Mr. Sylvester N. Stewart has invented a horizontal shaft with paddles arranged in the form of a spiral, which by trial in the current has proven to be effective. This apparatus has been exhibited before committees of the Merchants' Exchange and Real Estate Exchange, who have given it their approval and commendation, asking the general, State and municipal governments to grant privileges that will permit of its use in the Niagara River. Application has been made to the State board having in charge the breakwater pier running between the river and Black Rock harbor for permission to take the apparatus on such pier, and if such application is granted and the use of the current permitted where navigation will not be obstructed, it is expected that power will be generated for public use at very low cost. If such permissions are obtained it will be agreed that power shall be furnished at $20 per horse-power per year for 24 hours' use each day."

The application and papers have been referred to Major Symons, United States engineer, for his opinion and report. A very significant statement is that made by General Graves, when interviewed relative to the above petition. He said: "The fact is, that Buffalo, for all the newspaper talk, can count but little on securing any large amount of electric power from the Falls for some time to come, and, perhaps, never. Buffalo will only get from Niagara Falls the amount of power which the company cannot sell down there."

DANGER IN ELECTRIC MINING WORK.

In the "Mining and Engineering Journal," "S. T. J.," of Florence, Colo., writes as follows: I read with interest the article in the "Engineering and Mining Journal" of July 17, on "Precautions Against Fire in Metallurgical Works," and wish to call the attention of parties interested to the risks of fire in many of the mills and reduction works throughout the West, arising from the manner of installing their electric plants. It is no uncommon thing to see wires conducting direct current 120 to 500 volts strung about the mill on wooden cleats, and drawn through timbers and floor joists, with only a low grade of weather-proof insulation to protect the wires and prevent leaks and short circuits. Another practice that ought to be prohibited—and soon would be if the insurance companies would refuse to take risks on buildings where it is done—is running circuits with wire as small as No. 16 B. & S. guage. This is sometimes done simply to make a cheap job, though if there is any class of work that pays to have well done, it is electric work. Another error is in wiring small isolated plants with so heavy a loss in the conductors. While this class of work is somewhat cheaper in the beginning, it is extremely expensive in the long run, both as regards fuel and lamp renewals.

ELECTRIC POWER IN A SCRANTON COAL MINE.

An electric locomotive in a Scranton coal mine shows a saving over mules of $2,528 in 200 days. The electric pump in the mine showed a saving over steam pumps of $1,513 in 970 days.

CARD SPECIAL FACTORY MOTORS.

TO meet the demand for special motors, to drive tools, etc., and occupying little space, the Card Electric Motor Company, of Mansfield, Ohio, have brought out the motor shown in the accompanying cuts (known as their S type), which can be

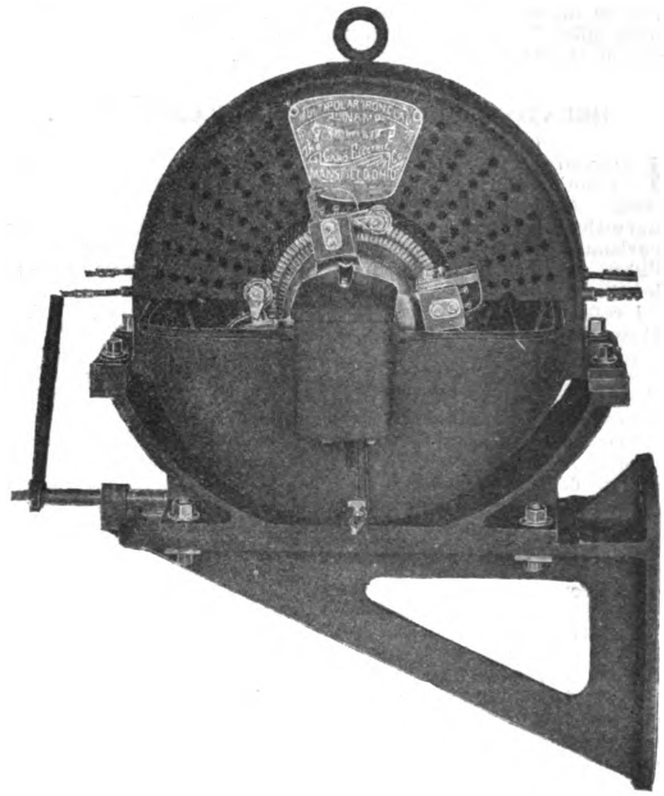


Fig. 1.—Card Special Factory Motor.

set on the floor, or supported from a post or wall, or suspended from the ceiling. Fig. 1 shows the motor with a bracket support for fastening to a post or wall. By changing the position of the armature bearings, i. e., turning them one-

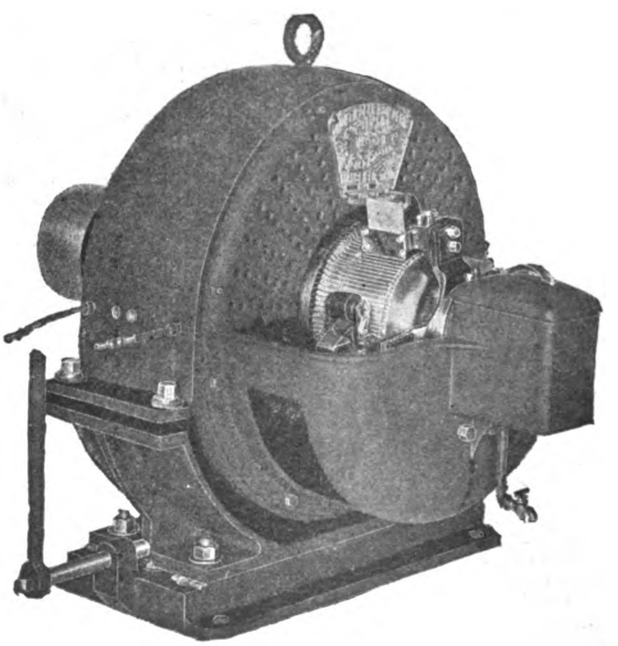


Fig. 2.—Card Special Factory Motor.

half round on the pole frame, the bracket will be brought above the motor which will then hang down. When the driving belt is to run horizontally from the motor or nearly so, this style of support is desirable, since the belt tightening screw is in the best position for quick adjustment.

The style of base shown in Fig. 2 is adapted to support the motor on the floor as shown in the cut, or by changing the position of the armature bearings, in order to keep the oil boxes right side up, from the wall or ceiling; and when the belt is to run nearly vertical this style of base is better than the bracket for wall support, because of the better position of the belt tightening screw. It is obvious that these motors can be used to drive shafting by gears as well as by belts when it is desirable to do so. As motors of this kind are frequently fastened to iron girders or posts in buildings, and therefore grounded, protection to the armature and field coils is provided for in the construction, by heavy insulation between the pole frame and base. In all other ways care has been taken to insure rigidity and lasting qualities. These motors are made in sizes up to 15 h. p.

ELECTRIC LIGHTING

THE EVOLUTION OF ELECTRIC LIGHTING FIXTURES.[1]

BY RICHARD N. DYER.

TO a manufacturer or dealer who entered the business after the present constructions had become standard, and without knowledge of the travail which preceded that result, electric and combination pendants appear to be only the ordinary gas fixtures with the wires and insulating joints added, and with such simple changes in construction as are required to accommodate those conditions. Back of this, however, there is a history which has never been and probably never will be fully written, and which is known only in part to those few manufacturers and dealers who participated in the early introduction of the incandescent electric lamp.

That lamp was invented by Mr. Edison in the summer and fall of 1879, and was publicly exhibited in operation on a considerable scale at Menlo Park, N. J., during the Christmas holidays of that year. The exploitation of this lamp as a substitute for gas for interior illumination was undertaken by The Edison Electric Light Company. During the year 1880, the only plant worth noting was that on the steamboat "Columbia," of the Oregon Navigation Company, plying between Portland, Oregon, and San Francisco, Cal. This boat had oil fixtures to which were added crude attachments for supporting incandescent lamps. The fixtures were made by Williams, Page & Company, of Boston, Mass. They were special constructions, which have never been repeated, and which furnish no indication of how to build pendants suitable for general use for the lighting of houses.

In February, 1881, The Edison Electric Light Company rented the dwelling house 65 Fifth avenue, located on the east side of Fifth avenue just south of Fourteenth street. It undertook to equip this building with a complete electric lighting plant which would show the possibilities of the incandescent lamp for interior lighting, both for offices and household uses. The rooms were to be provided with pendants corresponding in number and location to those which had been used in the house for gas, with a newel post standard, with a slide fixture, and with brackets. All these fixtures were for electric light only, no combination arrangements being included. The slide fixture and the brackets were special constructions, and are not interesting for the purposes of this paper. The contract for these fixtures was given to Mitchell, Vance & Company on specifications furnished by The Edison Electric Light Company. Mitchell, Vance & Company did the metal work, and called in Mr. Charles R. Hinds, a gas-lighting electrician of reputation, to furnish the electrical devices in accordance with the specifications. The fixtures were built on a patented idea of Mr. Edison's involving the "knock-down" principle. They were brass-finished fixtures, of a selected design for gas work, and were provided with large bodies open at the bottom, and in these open bodies were located large circular blocks of vulcanized fibre, upon which the electrical connections were made. Each arm of the fixture was wired complete, and the wires terminated at the inner end of the arm in two insulated contacts corresponding in principle to the contacts on the base of an incandescent lamp. The block of vulcanized fibre secured in the body of the fixture was provided for each arm with a set of insulated contacts corresponding in principle with the contacts in a lamp socket. The object was to enable the connections between the arm wires and the main or stem wires to be made by simply screwing the arm in place, and thus the fixture arms could be wired complete and the fixture taken apart or "knocked down" for shipment without disturbance of the wiring. The fixtures were not provided with any main stem wires by the manufacturers. These were to be provided by leaving the wires projecting from the outlet of sufficient length to enable them to be drawn through the pendant to its lower end and there secured by screws to the proper contact plates on the blocks of vulcanized fibre in the bodies of the fixtures.

The arrangements just described were actually carried out, the main wires being passed through the outlets by putting in T connections with the horizontal pipes in the ceiling, which T connections had openings at the center of the T for permitting the main wires to be run directly down through the outlet. The fixtures were delivered on March 15, 1881, and Mr. Luther Stieringer, at that time employed by Mitchell, Vance & Company, was given the work of erecting the fixtures. Stieringer was to have nothing to do with the electric work; that was in charge of an electrician for The Edison Electric Light Company. Difficulties arising from bad contacts, ground connections, etc., were soon developed; and after considerable tinkering to overcome these difficulties, Stieringer, with the consent of the Edison Company, took out the electrical contrivances in the fixtures and rewired them on the simple plan, at present employed, of soldering and tapping the joints between the stem and arm wires, and to avoid still other difficulties he opened the line of piping back of each fixture, leaving an air gap which cut off the fixture from the ground formed by the house piping. The result was satisfactory, and the electrical difficulties disappeared.

From this work Stieringer was brought to an appreciation of the fact that if internally wired fixtures of the general design of gas fixtures were to be made useful and were to be supported from the house piping, as he believed they should be in the case of simple electric fixtures and knew they would have to be in the case of combination arrangements, it would be necessary to provide a device which should form an effective mechanical connection between the fixture and the outlet, and an effective electrical separation or insulation between those parts. This resulted in the production of the insulating joint, two forms of which (one adapted for electroliers and the other for combination fixtures) Stieringer made about this time, the work being done at night at his house. It was some time later, however, before he had an opportunity to put his ideas to the test of practice, but these insulating joints he carried around in his pocket and showed to various people in explaining his notions relating to fixture work.

During the year 1881, several manufacturing establishments were organized for making the various kinds of apparatus required for incandescent lighting by the Edison Company, and an effort was made to get one or more of the gas fixture houses to undertake the manufacture of electric fixtures. None of these houses was found willing to go to the expense of developing the new forms and devices which would be presumably required, while they were quite willing to do work at the risk of the purchaser in accordance with specifications which might be submitted to them. Their position was thought by the electric light men to be antagonistic to the new industry, and perhaps it was, in the sense that there was no certainty that the new illuminant would furnish them with the same business opportunities as did the gas which it would replace; and, naturally enough, gas fixture manufacturers with an established line looked upon the new industry as involving experimental expense without an assured outcome.

In this situation the firm of Bergmann & Company was organized and a small shop established for the manufacture not only of fixtures but of miscellaneous small devices, such as sockets, safety catches and switches, which were not within the scope of the other Edison factories. That firm undertook the electric fixture business on lines quite independent of the gas fixture art. Their first pendants consisted of a simple iron pipe for the stem and a large cast iron body open at the bottom, in which the arms were screwed. The iron was given a bronze finish, and the bottom of the body was covered with a hard rubber cap, which, being black in color and presenting a different appearance from the finish of the fixture, was painfully conspicuous. A large block of wood was set in the body, and on this block were mounted plates to which the arm and stem wires were screwed. Circuit controllers having stems projecting through the hard rubber cap were also mounted on this block, as well as safety catches. These fixtures were provided with a crowfoot or with an equivalent device in the form of a closed cast-iron canopy with a flange for fastening screws; and whether provided with the crowfoot or the flanged canopy, the fixture was designed to be secured to a large base of wood, which, in turn, was attached to the

[1] A paper read before the National Association of Gas and Electric Fixture Dealers, Niagara Falls, August, 1897.

ceiling. The fixture as manufactured was wired complete in the arms, but the stem wires were omitted and were designed to be provided by wires extending from the ceiling which were to be drawn through the stem of the fixture and secured at their ends to plates on the wooden block in the body.

An improvement upon this construction introduced by Bergmann & Company was a similar fixture provided with stem wires which ended in a large plug attached to the top of the stem, this plug being similar to the base of the lamp, or to an attachment plug such as now employed, but made of wood and several times larger. To the ceiling was attached a large circular block of wood having a socket corresponding to the lamp socket, in which the ceiling wires terminated. By this plan a building could be wired complete, the wires terminating in the sockets in the ceiling blocks, and the fixtures could also be wired complete and could be attached in place by simply screwing the plug on the end of the fixture to the socket in the ceiling block, making at the same time a mechanical and an electrical connection.

A number of fixtures of the two kinds described were manufactured and shipped to the Paris Exposition in 1881, and a few, particularly of the kind supported by the crowfoot or flanged canopy, were put into use in this country. During this time electricians who did not care to use the Bergmann fixtures supported their lamps by means of such expedients as came to hand. Some gas fixtures were used with wires wrapped around the outside or carried to the lamps aërially, and in some instances a partial concealment of the wires was effected; but nothing in the way of a standard of construction was adopted except in the case of those fixtures manufactured by Bergmann & Company.

In the fall of the year 1881, Stieringer wired and hung, in accordance with his own ideas, electric light fixtures in the house of Mr. J. Hood Wright, in New York City, and in the spring of 1882 did similar work in the house of Mr. J. W. Doane, of Chicago. Both Mr. Wright and Mr. Doane were interested in the Edison business. Having thus demonstrated to his own satisfaction the success of his plan of using internally wired gas fixtures supported by insulating joints, Stieringer applied for his patents covering the use of the insulating joint in connection with electric and combination fixtures of this character. His work, however, had not so strongly impressed the electric light people as to effect a change in the character of the fixtures manufactured by Bergmann & Company.

The recognition of the merit of gas fixture designs for electric fixtures, and of Stieringer's method of using them, was of slow growth, and only came about by the gradual introduction of the incandescent lamp for interior illumination in locations where the users would not consent to the lack of ornamentation and artistic effect which had become a standard in connection with gas lighting. As the business grew, the frequency with which fixtures of this class were required, and the dangers from fire which their use involved, brought the subject to the attention of the fire insurance interests, who formulated rigid rules as to the separation of wires carrying the electric lighting current from each other and from other conducting bodies which, if enforced, would have prohibited the use of internally wired metallic fixtures. Indeed, the insulated wire at that time on the market was quite unsuited to the work, and it is questionable whether the fire insurance underwriters would ever have permitted the internal wiring of metal fixtures as a regular practice if improved forms of insulation had not been developed.

Stieringer's plan of introducing an insulating joint between the fixture and the outlet reduced the danger considerably, and in 1884 the New England Insurance Exchange adopted a rule requiring the employment of insulating joints when fixtures were hung from grounded supports. This requirement, which was adopted later by fire insurance underwriters throughout the country, together with the improved forms of insulated wire which were developed, resulted in the general adoption of the present standards of construction in the electric fixture business, and the gas fixture manufacturers, commencing first with the larger houses, and extending subsequently throughout the trade, took up the manufacture of electric and combination fixtures as a part of their regular business.

A review of the entire situation shows that it was the insulating joint and the ideas involved in its use which led to the present universal employment of gas fixture designs for electric and combination fixtures. Without the insulating joint, a form of insulated wire having a high insulation protected mechanically by some armor which would prevent abrasion might have been finally developed and would have enabled the safe internal wiring of metal fixtures without the use of the insulating joint. Such an improved insulated wire might have been produced as the result of the pressing demand for it in the absence of the insulating joint; but it is apparent that with the imperfect insulations which existed in the early days of the electric lighting art, and which still exist, the insulating joint is the foundation upon which the present electric fixture art rests. That joint and its use in this connection were invented by Stieringer and are covered by his patents, to which, in view of the meritorious results accomplished, full credit should be given.

To this very complete statement by Mr. Dyer may be added the fact that Mr. Maitland bought into the Stieringer patents in 1888. It is expected to have the suit against the Goetz Company argued at final hearing in the Circuit Court in New York early in the fall. Whichever way the case is decided, it will undoubtedly be appealed in the Circuit Court of Appeals for that circuit. When that court will decide the case cannot now be determined. The earliest possible date is about the end of the present year. When that decision is given, it will be the "ultimate" decision for that circuit, and probably for other circuits.

LETTERS TO THE EDITOR

MUNICIPAL PLANTS.—MR. A. E. WINCHESTER'S COMPLIMENTS TO MR. M. J. FRANCISCO.

SOME time ago my attention was drawn to an interesting article on "Municipal Ownership," from the facile pen of our oily-minded friend, Mr. M. J. Francisco, in the "Electrical World" of June 5. Now the writings of this learned gentleman, who has striven so unceasingly to fan the sickly flame of his little star of doubtful magnitude into sufficient brilliancy to be noticed among those which shine with the lustre of honest fame, are always interesting and instructive to me; interesting because of the deep and unselfish solicitude exhibited by him at every opportunity in behalf of unwary municipalities which have been so audacious as to assume that they had rights equal to those of private corporations to own and operate electrical plants. Instructive, because of his exhaustless fund of truly original statistics—undoubtedly gleaned only from his productive brain—which he generously ventilates before the public as facts, even ready to create opportunities where they are lacking in his anxiety for the public's good to sound his warning against the terrible consequences which, according to his views, are the inevitable results of "municipal ownership." He reminds one somehow of the oldtime, so-called temperance lecturer with his educated stock of horrible examples of the lowest extremes, which he endeavors to impress upon his hearers as pictures of what they are bound to come to unless they repent and follow his advice.

This particular article of friend Francisco's, however, was of unusual interest to me, for the reason that he devoted considerable of its length to an unwarranted attack upon the South Norwalk, Conn., municipal plant, the gratifying results of which seem to have caused him some anxiety, possibly because they have given practical proof to the contrary of his pet theories, and in order to maintain them and, being unable to call upon honest truths, to help him, he resorts, as a forlorn hope, to distortion and misrepresentation, a means of argument that no man possessed of a high standard of character would stoop to. Nor would any but a man of his methods unhesitatingly cast suspicion upon the honesty of those who are responsible for the management of that or any other plant who were utterly unknown to him. Right here it may be proper for me to explain that my interest in the South Norwalk plant is largely due to the fact that it was constructed some five years ago, under my supervision, since which time I have had the honor of being one of the board of three commissioners elected by our citizens to assume the responsibilities of its management.

Mr. Francisco's criticisms no doubt were sincere, according to his standard of measure, which seems to look only on one side, and probably his easy manner of jumping at conclusions when the facts were not to his liking, gave more or less color to his argument as it may have appealed to the uninitiated, but to one acquainted with the real facts it was perfectly clear that he had made extravagant use of assumptions that could emanate only from the combination of a pen and an unscrupulous writer.

Realizing the greatness of this man as one gifted with such long-distance penetration as to enable him to describe what he has never seen, and whose knowledge of central station

matters and municipal plants in particular is so voluminous, I felt too timid to attempt a reply to his article, and I trust he will pardon this effort, but in behalf of numerous friends from various sections of the country, not inclined to view things municipal in the same light as Mr. Francisco, who have been urging me to get up and say something, I at last in an unhappy moment consented, so the blame for my possible lack of discretion must rest upon them.

It would be becoming in me, I suppose, to proceed with fear and trembling and apologize for my extreme youth and the paltry dozen years of experience that it has been my good or ill fortune to have had in connection with central station work, but somehow as I have always been a direct current sort of a fellow rather than one of the high frequency order, it is difficult for me to produce much of a tremble. First, I would like to state that in so far as the South Norwalk plant is concerned, Mr. Francisco knows nothing of his subject, never having honored it with a visit, as is evidenced by what he has said concerning it, although he is most cordially invited to call at any time with full liberty to examine with microscopic nicety into every detail from the coal pile to the lamp trimmers' record. It would not take long as the plant is small, plain and simple; and it is managed on the same lines. Satisfaction and good results are all that we are after, and we get them. If he can discover anything contrary to what we publish in our annual reports or that will give the substance of truth to his allegations, he will have the distinction of being the first critic to succeed in such an attempt among the many experts who have visited the plant for the purpose of personal investigation. Some of them have even come armed with Mr. Francisco's funny little pamphlets, and nearly all have been biased against municipal plants in general. But they were honest enough without an exception to acknowledge that they found all as represented and extended compliments in place of criticisms.

The figures and quotations which Mr. Francisco alleges to have gathered from some of the annual reports of the South Norwalk plant indicate only a base attempt to distort facts, in the belief that no one would take the trouble to expose him. For instance, he asks if an armature was not burned out to account for an item which he knows was properly charged. But he would attempt to surround it with mystery so as to create a suspicion of irregularity which is groundless as the plant has never burned out an armature during the five years of its existence.

He further quibbles over the varying ratings of candle-power in the different reports, but fails to quote the careful explanation given. It is only necessary to state that the lamps used are of the Western Electric arc type, which adjust themselves to a varying range of amperes, and that the brilliancy is thereby increased or decreased as desired to suit requirements. An average nominal candle-power rating can only be obtained from the record of watts consumed. He tries to load an item for insurance upon the plant when it is fire-proof, and none is carried. Again, he adds 8 per cent. depreciation against the entire investment, when the real estate on which the plant stands has advanced in value and the 5 per cent. carried is ample. Then he speaks of a lawsuit for $20,000 against the plant. This is an absolute falsehood. In answer to his misleading statement concerning the tests of the plant made about a year ago, it is only necessary to quote the concluding remarks of the signed reports of the engineers who made them, which are as follows:

"The showing made by this test is very good considering the size of the plant and the conditions of load. The largest loss is in the boiler, where but 37 per cent. of the heat of coal is utilized. Good average practice for this type of boiler is from 60 to 65 per cent. The poor showing of this boiler is due to the fact that it is being worked at less than half its rated capacity. The performance of the engine was in conformance with good practice and would show up remarkably well if more heavily loaded. The performance of the station as a whole as regards coal consumption and cost of power compares more than favorably with stations having many times the output of this plant, and with a larger load the results would be highly gratifying to the designers and those in charge of the plant. (Signed) CHAS. E. BARRY."

Mr. Edgerton states in commenting upon the results of his report that "the above showing is considerably above the average of stations of equal or even greater output," and he highly commends the distribution of the lights on the streets as being "far more effective than 2,000 c. p. lamps at greater distances apart," and concludes by saying that results shown in the report are "due more to efficient management than to the excellence of the machinery."

(Signed) H. H. EDGERTON.

These were the exact and only data that Mr. Francisco had before him when he wrote, and I will add that they were made by two experts who visited the plant for personal investigation and were granted permission to make a complete test at their own expense, which they did with great care. It does not seem worth while to reply to any more of his assertions. Altogether too much space would be consumed by so doing, when the final result would only be to prove that he was wrong in every particular. To say that he has lied would be the plain English of it, and now it seems to me, in view of a charge so strongly put, that Mr. Francisco owes it to the position in which he has of his own free will placed himself, to prove his statements or admit the truth of the above; just how he can do either with grace is not plain, though his particular brand of resources will probably present a means satisfactory to himself, at least. If all of his statements concerning other municipal plants are as false as those in regard to the South Norwalk plant, which, I am quite inclined to believe is so from such information as has come to my notice, then his whole article must be substantiated with something more reliable than his mere assertions or pass as a mass of fabrication that will injure rather than benefit the cause he assumes to defend.

I do not consider myself qualified to advance extreme ideas for or against municipal or private plants, as my interests are with both, so long as either are conducted as public satisfying institutions; as to financial results and management I believe the two systems stand about even and my sympathies are drawn to the municipal side of the question only for the reason that I detest the injustice which has been so freely resorted to by those interested in private plants, whose agents have too often, as this man Francisco has done, cast honor to the winds, not hesitating to call to their aid lies and slanderous assumptions in the place of facts, which they dared not use, greedily grasping at isolated instances of mismanagement of municipal plants, which they have magnified out of all proportions, forgetting that such instances occur with equal frequency in privately owned plants. Undoubtedly Mr. Francisco himself could tell us of such a plant not a thousand miles from Rutland, with which he is quite well acquainted as an influential officer—a plant which, if hearsay is to be believed, has never given any remarkable signs of prosperity, notwithstanding the fact that it is under the eye of one who has constituted himself a criterion upon central station management.

I think sufficient evidence has been given herein to show the methods he uses in an agonizing effort to disprove the statements of honorable men unknown to him, who have no other aim but to do their duty and by so doing have earned his animosity by furnishing the most convincing proof that it is just as possible for a municipality to operate an electric plant with profit as it is for a private corporation to do so.

Our reports and business methods are open to all, and I defy Mr. Francisco to quote in full the passages and figures from which he has drawn his assumptions, so that those who may have innocently swallowed his story can see the truth, when possibly that old familiar adage will occur to them that "figures won't lie, but liars will figure."

ALBERT E. WINCHESTER.
Elect. Lt. Commissioner.

South Norwalk, Conn., August 17, 1897.

THE INCONSISTENCIES OF INSURANCE RULES.

My attention was called in your last issue to some inconsistencies in the rules of the National Board of Underwriters in reference to interior conduit wiring. These inconsistencies as pointed out are only a few drops in the bucket compared with what has been, or possibly may be, as long as vacillating ignoramuses in electrical matters are allowed to remain at the head of important departments. The criticism of "Bald Eagle," in comparison with former evidences of incompetence, is scarcely worth noticing.

This whole department of fire insurance has been secretly ridiculed from its incipiency by the well posted, common-sense members of the electrical fraternity; and justly, for to such an extent have they been foolish and contradictory in their rules for wiring buildings, that, in the minds of many (including some of their own inspectors, better informed than themselves) it has often been a conundrum whether they have done themselves, or, more correctly speaking, the insurance interests, more good than harm. To speak right out in meeting, there are a few who claim that some of the members have bettered their financial condition, otherwise than from a salary. There are others who believe that money "placed where it would do the most good" attended with a little sophistry in the way of argument, has been responsible for some of the glaring defects and absurdities in their rules.

In writing about these unpleasant matters I use a nom de

plume for business reasons, and personal ones as well. Some of us have found out that at times there is a disagreeable discrimination when it comes to the application of these remarkable and wonderfully drafted rules—in fact, we very soon find new, and unseen as well as unexpected, evidences of subtlety in ways that are dark and peculiar; and, strange to say, we soon commence to see more wisdom displayed than formerly in these insurance absurdities.

What we learn from experience we do not readily forget; I am speaking from experience, and there is no doubt of the vividness of my impressions.

Then, again, there has been discrimination where the rules do not apply. The independent position of the board, from whose decisions there is no court of appeal, has placed manufacturers at their mercy, and they have in instances been merciless until the manufacturers have found that something, other than argument, or tests, and demonstrations of the merits of their articles, talked louder than words, and carried more weight with certain individuals. They would say, in effect: "Whatever this board passes will be accepted all through the country. This is worth much money to you, and we should be paid (individually) for the prestige we give you." . . . This is not blackmailing, neither is it soliciting bribes; of course, not, for an even exchange is not robbery.

The personnel of the present board is not made up of this class of people, the writer has been recalling reminiscences of the long ago, and in speaking of those times let me, in justice, add that the inspectors and lower officials in general, especially in cities outside of New York, considered the honor of their position, and the salary connected therewith their sole recompense, until their merits could be recognized by a well merited advance, through close attention to the interests of the insurance they were paid to protect. SORE HEAD.

New York City, Aug. 24, 1897.

OBITUARY

A. DE LA M. LOZIER.

It is with extreme regret that we record the death of Mr. Arthur De La M. Lozier, assistant manager of the Bullock Electric Company, of New York City, from typhoid fever, at the home of his sister, Mrs. S. H. Payne, on Staten Island. Mr. Lozier had not appeared to be dangerously ill, and his death came with a great shock. He was only twenty-three years of age, a young man of great promise and ability, as well as of strength of character and amiability. He was a son of Mrs. Jennie De La M. Lozier, M. D., dean of the New York Medical College and Hospital for Women, and of the late Dr. A. W. Lozier, Mr. R. T. Lozier, of the Bullock Company, being his step-brother. Funeral services were conducted at the Episcopal Church, New Brighton, S. I., on Sunday afternoon, and were largely attended by friends of the family. Mr. Lozier was an associate member of the American Institute of Electrical Engineers, and was a chief signalman on the non-commissioned staff of the First Naval Battalion of New York. He took a lively and active interest in public affairs and in professional matters, and bade fair to rise high, but for his sad and untimely death.

EDWARD L. FRENCH.

It is with sincere regret that we have to announce the death of Edward L. French, which occurred quite suddenly, on August 21, at St. Vincent's Hospital, Toledo, Ohio. Mr. French recently met with an accident while at Put-in-Bay, O., which caused an injury to his spine, and while in the hospital succumbed to an attack of paralysis. Mr. French has for some time past been one of the traveling representatives of the American Electric Telephone Company, of Chicago, and was greatly esteemed by his employés, as well as by all his business and personal friends. He was twenty-six years of age, and his numerous acquaintances will mourn his untimely decease.

MR. C. W. KORNER, or Laurel, Md., writes: "By reading The Electrical Engineer I am kept posted on up-to-date electrical engineering."

NEWS AND NOTES

DATA OF TROLLEY ROADS IN NEW JERSEY.

A supplemental report of the State Board of Assessors, giving advanced statistics regarding the electric and street railroads in New Jersey for the year 1896, shows the total receipts of all the street railroads in the State for the year to be $5,770,171, against $5,056,598 in 1895, an increase of $713,573. The expenditures were $3,546,168, against $3,431,931 in 1895, an increase of $144,236, and dividends paid $124,220, against $117,320 in 1895, an increase of $6,900. The number of miles of track in the State is 613; capital stock paid in, $38,235,150; funded debt, $36,420,493, and other debts, $4,279,396; total of capital and funded debt, $78,935,039. The total cost of the railroads, including the equipment and appurtenances, is put at $80,011,559, an average of $130,500 per mile of track. The total assessed valuation of all steam railroads in the State, including roadbed, equipment, depots and depot grounds, terminals, bridges, franchises and all other tangible and personal property, is less than $95,000 per mile.

WHY THE LIGHT FLICKERED.

The Stamford (N. Y.) Electric Light Company uses wood for fuel instead of coal. The other night the lights were unsteady, flickering, etc. The next morning, a guest of Churchill Hall asked Engineer Corbin the reason the lights flickered, and Corbin told him it was "caused from burning the darn crooked wood."—Mirror.

PRODUCING OZONE ELECTRICALLY.

In the "Journal of the Society of Chemical Industry," M. Andreoli remarks that, though theoretically one should be able to produce a kilo of ozone per electric horse-power, in practice only 10 or 12 grams are obtained. By improvements, however, in apparatus for the production of ozone, M. Andreoli is now able, he contends, to increase the amount to 30 and in some cases even fifty grams per horse-power, making the cost about 75 cents a kilo. This, if a practical thing applicable on a large scale, is important. Based on these results experiments are to be made by him in various directions, to ascertain the value of the process in commercial affairs, such as the purification of drinking water, the cleansing of beer casks, preparing wood for instruments and furniture, bleaching of starch and dextrin, oxidation of drying oils, purification of wine and brandy, etc.

LEGAL NOTES

DECISION ON SPIRAL COIL HEATERS.

Mr. F. W. Kelley, assistant treasurer of the Consolidated Car Heating Company, of Albany, N. Y., writes us as follows under date of August 28.

We would be glad to have you print the following relating to our recent favorable patent decision in the next issue of The Electrical Engineer:

On August 25, Judge Putnam, of the United States Circuit Court for the District of Massachusetts, rendered a decision in favor of the complainant, with an order for an injunction and accounting, in the suit of the Consolidated Car Heating Company, of Albany, N. Y., against the American Electric Heating Corporation and the West End Street Railway Company, of Boston, Mass. This is the suit for the infringement of the patent to James F. McElroy, covering the Consolidated Car Heating Company's spiral coil construction of electric heaters, which is now used in the majority of street cars operating electric heaters in this country. It is considered a most important victory.

HART & HEGEMAN CO. VS. ANCHOR ELECTRIC CO.—SNAP SWITCH LITIGATION.

On August 20, in the United States Circuit Court, at Boston, Mass., in the case of the Hart & Hegeman Manufacturing Company against the Anchor Electric Company, Judge Putnam ordered the respondents to file a draft decree dismissing the bill with costs. This action was for the infringement of a patent for snap switches. In his opinion, Judge Putnam says that the Anchor Electric Company's manufacture is a device clearly described and fully covered by a patent issued to Norman Marshall, vice-president of the Anchor Electric Company.

Judge Putnam further finds that the switches manufactured by the Anchor Electric Company in nowise infringe the Hart patent, and, in conclusion, says: "If the complainant has any remedy it is not in the courts, but in convincing the purchasing public that the device of the respondents is less simple, economical and compact than his own."

C. F. Mitchell, New York, for complainant; E. P. Payson, Boston, for defendant.

DAMAGES FOR JUMPING FROM TROLLEY CAR.

Henry Poulsen sought to recover damages from the Nassau Electric Railway Company, of Brooklyn, for the loss of the services of his infant child, and on the trial of his action it appeared that the child saw a blaze of fire coming from the box alongside the motorman and becoming frightened jumped from the car and was injured. The Second Appellate Division has reversed the judgment below, dismissing the complaint, holding that the railroad company was called upon to explain the cause of the fire. Proof upon its part that a fuse blew out was not sufficient to exempt the corporation from the implication of negligence, the blowing out of the fuse not being ordinarily attended by any other display than a flash of light.

SOCIETY & CLUB NOTES

N. Y. STREET RY. ASSO'N will meet at Niagara Falls, Sept. 14 and 15; headquarters, the International Hotel.

A NATIONAL CONVENTION of mayors and city councilmen is to be held at Columbus, Ohio, September 28, 29 and 30 and October 1, when a large number of subjects of public interest are proposed for discussion. Mayor Black, of Columbus, is chairman of the General Committee.

THE EDISON CONVENTION will be held at Niagara Falls on September 14, 15 and 16, and both President Insull and Secretary Barstow look forward to a very large attendance and to an unusually good meeting in the way of papers and discussions. Headquarters will be at the Cataract House.

THE TORONTO MEETING.—Our esteemed contemporary, the "Electrical Review," states that it was the only electrical journal represented at the Toronto B. A. meeting. The matter is not one of much account, but we may say for ourselves that The Engineer was ably and specially represented by Mr. E. Tremlett Carter.

PERSONAL

E. G. ACHESON, president of the Carborundum Company, of Niagara Falls, was held up and robbed on the night of Friday, August 27, within a few doors of his home in Buffalo. Mr. Acheson had left his house, No. 41 Fargo avenue, to go to the depot, intending to take a train for Pittsburg. It was 11 p. m., and Mr. Acheson's cry of "Murder" startled the neighborhood. He was picked up unconscious and carried to his home, where he revived and described how three young men had attacked him. Two severe scalp wounds told of their ugly work. Mr. Acheson was relieved of his gold watch, a memorandum book and some private papers, but the book and papers were dropped by the thieves. The police believe he was struck by brass knuckles. What money Mr. Acheson carried was in an inside pocket, and this the thieves did not get. While Mr. Acheson's injuries are severe, his full recovery is early expected.

MR. SETH C. ADAMS advises us that he has resigned his position as secretary and treasurer of the Bossert Electric Construction Company, of Utica, N. Y., taking effect this week. Mr. Adams has not yet made any definite plans for the future.

HOMEWARD BOUNDERS.—Among the recent arrivals from Europe of people well known in the electrical field are Messrs. C. O. Mailloux, R. W. Blackwell, H. F. Parshall, John McGhie, A. C. Shaw, E. J. Wessels and G. T. Montgomery.

MR. G. R. SCRUGHAM, of the Creaghead Engineering Company, Cincinnati, O., is a special committee of the street railway and electric supply men of Cincinnati to get the next meeting of the American Street Railway Association in that city. Why not?

MR. C. F. HUTCHINGS, who has been superintendent of the Wilmington, Del., City Railway Company for the past two years, has resigned. Mr. Preston Lea, the president of the company, becomes general manager, and Mr. H. B. Vandegrift assistant to the general manager.

MESSRS. CREHORE AND SQUIER have been making some successful demonstrations in England, between London and Birmingham, with their new system of high speed telegraphy.

PROF. W. S. FRANKLIN, of the Iowa State College, has succeeded Prof. H. W. Harding in the chair of the department of physics and electrical engineering, at Lehigh University. Prof. Harding had held the chair twenty-five years. The trustees in accepting his resignation have made him emeritus professor of physics.

THE STOCK MARKET

STEADY ADVANCES.

THE general gains in trade and finance reported last week still continue. Bank clearings and railroad earnings are all higher again, a great many staples have been firm in price or have advanced, and considering the season of the year the number of industrial plants set going again or becoming more active is remarkably large. There is every indication that the fall trade will be unusually good.

On the New York Stock Market last week 36,795 shares of Western Union were sold, rising from 92 up to 93⅛. Of General Electric, 11,445 shares were sold around 37½. American Bell Telephone on sales of one or two hundred shares reached 240.

COPPER is firm at 11¼ cents for Lake Superior ingot, and 11 cents for electrolytic.

REPORTS OF COMPANIES

THE PENNSYLVANIA-SIEMENS HALSKE COMBINATION.

Formal consolidation of the Siemens & Halske Electric Company, of Chicago, and the Pennsylvania Iron Works Company, of Philadelphia, has been effected. It was announced last week that all but about 300 hundred shares of the capital of the Siemens-Halske Corporation had been exchanged for stock of the Pennsylvania Company, so that the latter is now in the control of the Chicago Corporation. The offer of the Pennsylvania Company to take over the stock of the Chicago concern became operative June 17, and the shareholders of the Siemens-Halske Company were given sixty days, or until August 17, to accept the proposition. The option expired, consequently, with the result, it is said, that every shareholder in this country has made the exchange. Friends of those absent have assured the chairman of the committee having the matter in charge that their stock would in due course be also exchanged. The general manager of the Pennsylvania Company, B. W. Grist, is now in Chicago and is managing the Chicago works. The Pennsylvania Company's letter-heads announce that it is operating the Siemens-Halske electric works of Chicago. The capital of the consolidated concern would, it was announced a short time ago, be $5,000,000, and that it would be

listed on the leading stock exchanges of the country. The issued capital of the two corporations stands as follows:

	Penn. Co.	S. & H. Co.	Total.
Preferred	*$1,750,000	$700,000	$2,450,000
Common	1,500,000	1,275,000	2,775,000
Total	$3,250,000	$1,975,000	$5,225,000

*Six per cent. non-cumulative.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 17, 1897.

Alarms and Signals:—

ELECTRIC BURGLAR ALARM. C. Coleman, Chicago, Ill., 11,626. Reissued. Filed Nov. 10, 1896.
Employs a meter connected to the main circuit and adapted to complete the alarm circuit upon a variation in the current.

Batteries, Primary:—

APPLICATION OF SOLAR HEAT TO THERMO BATTERIES. H. C. Reagan, Jr., Philadelphia, Pa., 588,177. Filed May 15, 1896.
Employs mirrors to focus the sun's rays to one set of junctions and means for cooling the other set of junctions of the battery.

Batteries, Secondary:—

ACCUMULATOR BATTERY. J. V. & H. H. Sherrin, London, Eng., 588,189. Filed March 22, 1897.
Each element consists of a core of non-conducting material, a lead conductor strip wound helically around the core, and an outer non-conducting strip wound helically around the lead strip in the opposite direction.

Conductors, Conduits and Insulators:—

ELECTRICAL CONDUCTOR. J. D. Bishop, New York, 588,382. Filed May 6, 1897.
Composed of a plurality of wire ribbons wound side by side longitudinally of the conductor and having intervening air spaces.

Dynamos and Motors:—

COMBINATION VOLT GRADUATOR. W. J. Shields, New Wilmington, Pa., 588,246. Filed March 24, 1897.
Details of construction.

DIRECT CURRENT GENERATOR. B. G. Lamme, Pittsburg, Pa., 588,279. Filed May 8, 1896.
Details of construction.

BRUSH HOLDER SUPPORT FOR ELECTRIC GENERATORS AND MOTORS. S. H. Short, Cleveland, Ohio, 588,490. Filed Jan. 2, 1897.
Embodies an adjustable rocker mounted concentrically with the commutator and a plurality of radially adjustable brush-holder hangers.

MULTIPOLAR DYNAMO, MOTOR, OR ROTARY TRANSFORMER. S. H. Short, Cleveland, Ohio, 588,491. Filed March 12, 1897.
Method of winding to reduce reluctance.

Lamps and Appurtenances:—

CARBON HOLDER FOR ELECTRIC LIGHTS. O. S. Moss, Syracuse, N. Y., 588,233. Filed Nov. 2, 1896.
Comprises a base having a concavity in its lower face and provided with lateral ears and side pieces, having eyes in their upper ends adapted to grip the carbon.

HOLDER FOR INCANDESCENT LAMPS. C. H. Otis, Orange, Conn., 588,348. Filed March 10, 1897.
Details of construction.

Measurements:—

METHOD OF AND APPARATUS FOR MULTIPLE RATE METERING FOR ELECTRIC CURRENTS. E. Oxley, Washington, D. C., 588,170. Filed June 19, 1897.
Consists in connecting with each of a series of consumers' circuits a series of metering mechanisms and controlling their operation from the central station.

Miscellaneous:—

TREATMENT OF PHOSPHATES. G. De. Chalmot, Leaksvillè, N. C., 588,266. Filed Dec. 20, 1895.
Consists of fusing the phosphate in an electric furnace, removing the molten phosphate from the furnace into contact with silica, and then while still hot dropping it into water.

ELECTRIC FURNACE. G. De Chalmot, Leaksville, N. C., 588,267. Filed Dec. 24, 1895.
Embodies an overflow opening combined with a revolving part arranged beneath it to receive the overflowing material.

ELECTROLYTIC PROCESS AND APPARATUS THEREFOR. C. Kellner, Vienna, Austria-Hungary, 588,276. Filed Feb. 24, 1896.
A process adapted for the decomposition of compounds whose electropositive constituent will form an amalgam with mercury.

TROLLEY BICYCLE. R. T. Oney, Charleston, W. Va., 588,465. Filed Sept. 10, 1896.
Employs a trolley adapted to carry the supply and return conductor, and driving mechanism geared to the wheel of the bicycle.

ELECTRIC HERB PAD. A. Roedel, New York, 588,479. Filed June 10, 1897.
A bag containing herbs and metal plates, adapted to set up a current by galvanic action.

APPARATUS FOR TREATMENT OF DISEASES. H. Sanche, Detroit, Mich., 588,483. Filed May 29, 1890.
Details of construction.

ELECTROLYTIC APPARATUS. E. Balbach, Jr., Newark, N. J., 588,524. Filed July 2, 1896.
Embodies a removable anode suspended in the tank.

MEANS FOR LOCKING ELEVATOR CONTROLLERS. Thomas G. Turner, New York, N. Y., 588,540. Filed Nov. 30, 1895.
Employs a fluid check to operate the stopping and starting mechanism when the door is open and the car is at a standstill.

ELECTRIC FIRE ENGINE. George W. Cox, Stuart, Iowa, 588,399. Filed Dec. 30, 1895.
Embodies an electric motor and a rotary pump on the same shaft.

Railways and Appliances:—

ELECTRIC TROLLEY DEVICE. S. Harris, Johnstown, Pa., 588,144. Filed Dec. 3, 1896.
The trolley wheel is mounted on a transverse shaft to permit of longitudinal motion.

ELECTRIC TROLLEY DEVICE AND CONDUCTOR CONSTRUCTION THEREFOR. S. Harris, Johnstown, Pa., 588,145. Filed Jan. 20, 1897.
Employs a relatively large contact wheel adapted to compensate for lateral variations in the conductor by turning on its own axis.

ELECTRICAL RAILWAY SYSTEM. W. B. Purvis, Philadelphia, Pa., 588,176. Filed June 29, 1896.
A sectional conduit system in which the contact is made by depressing a pin within the conduit by means of a flexible strip carried by the car.

ELECTRIC CONTACT DEVICE. D. S. Shallenberger, Johnstown, Pa., 588,188. Filed Jan. 30, 1897.
Similar to No. 588,144.

ELECTRIC RAILWAY SYSTEM. J. Claret & O. Vuilleumier, Paris, France, 588,396. Filed Aug. 4, 1896.
Distribution for electric railways. Details of construction.

RAIL BOND FOR ELECTRIC RAILROADS. V. E. Hunter, Cleburne, Tex., 588,435. Filed June 24, 1897.
A copper band adapted to be fastened to the rail by means of a bolt, around which it is wound once.

TROLLEY. F. Krabal, Pittsburg, Pa., 588,448. Filed Aug. 22, 1896.
Embodies guards movable laterally and extending above the trolley wheel and across the conductor.

TROLLEY. G. W. Sell, Jr., Johnstown, Pa., 588,488. Filed March 11, 1897.
Consists of a globular bearing, a wheel and cups carried by the wheel and adapted to embrace the bearing.

ELECTRIC RAILWAY. R. M. Hunter, Philadelphia, Pa., 588,528. Filed July 19, 1896.
Employs accumulators to store the surplus current taken by the car.

CURRENT CONDUCTING RAIL FOR ELECTRIC RAILWAYS. L. E. Walkins, Springfield, Mass., 588,541. Filed May 21, 1897.
Comprises a body of iron or steel having its tread side covered with a layer of copper.

ELECTRIC MOTOR CAR TRUCK. G. M. and J. A. Brill, Philadelphia, Pa., 588,391. Filed March 25, 1890.
Embodies a cross bar constituting a holder for the motor and resting on its truck bars with springs interposed.

Regulations:

AUTOMATIC RHEOSTAT CONTROLLER. R. Wilson, Louisville, Ky., 588,306. Filed May 29, 1897.
Designed for operating electric elevators and hoists.

Switches, Cut-Outs, Etc.:—

PROTECTIVE APPLIANCE FOR ELECTRICAL APPARATUS. A. S. Williams, Newton, Mass., 588,206. Filed May 7, 1897.
Consists of a thimble provided with a heating coil at one end, an insulating pin extending from the opposite end through the coil, and a tube concentric with and soldered to the bobbin of the coil.

LIGHTNING ARRESTER. C. C. Chesney, Pittsfield, Mass., 588,320. Filed May 14, 1897.
Comprises a series of concentric cylinders having flaring sides, the cylinders being spaced throughout their length, suitable insulated supporting means and circuit terminals therefor.

FLUSH SWITCH. L. Heck, Newark, N. J., 588,428. Filed April 19, 1897.
Of the push button type.

MAGNETIC SWITCH LOCK. S. H. Short, Cleveland, Ohio, 588,489. Filed Dec. 22, 1896.
Details of construction.

FUSE BLOCK. H. A. Sinclair, Brooklyn, N. Y., 588,536. Filed March 9, 1897.
The contact pieces are joined together in pairs.

Telegraphs:—

RECORDING INSTRUMENT. W. Thomson, Largs, Scotland, 588,251. Filed Oct. 2, 1896.
Comprises a marking point and paper and means for oscillating it to and from the marking point.

Telephones:—

SWITCHBOARD APPARATUS. W. F. Banks, Milford, Conn., 588,258. Filed Oct. 1, 1896.
Call signal system for telephone switchboards.

TRANSMITTER. A. Van Wagenen, Sioux City, Iowa, 588,511. Filed April 30, 1896.
Designed for use in automatic telephone exchange systems.

WHO OR WHICH?

A Jamaica, West Indies, newspaper has the following: Our Newport correspondent writes: "A sad fatality happened at Rose Hill on Saturday morning last, the 31st ult. Mr. J. Swaby (formerly a teacher at Broughton) mounted his mule and joined two or three others, intending to proceed to some pasture to look after stock there. A vivid flash of lightning struck the group and both Mr. Swaby and his mule were struck dead on the spot. His companions were terror-stricken and could only gaze in consternation at their late friend. The remains passed through Newport on Sunday morning, followed by several buggies (for he was universally respected) on its way to Ebenezer Church, where they were interred."

MR. F. E. BRINER, a well known electrician in St. Louis, writes: "Have been a subscriber for several years and can't be without it."

TRADE NOTES & NOVELTIES

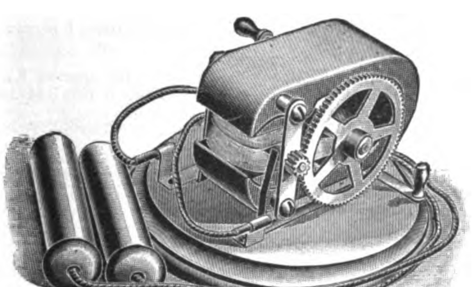
C & C SUCCESS.

The C & C Co. a number of years ago installed in the printing house of the American Bible Society an electric power transmission system, in which their bi-polar motors and dynamos were used. Among the directors of the company was Mr. John N. Stearns, Sr., head of the firm of John N. Stearns & Co., operating large silk mills in New York City, Williamsport, Pa., and Petersburg, Va. The machinery installed in the Bible House was so very satisfactory that it appealed at once to Mr. Stearns, with the result that a month ago that gentleman ordered a 40 kilowatt C & C multipolar generator for lighting their Williamsport mill, without the formality of receiving quotations from other manufacturers. This was followed later by an order from the same company for their Petersburg, Va., mill, covering one of the largest and most complete isolated power transmission plants in the United States, consisting of three multipolar generators, one 120 kilowatt and two 100 kilowatt, and 11 motors, three of 50 horse-power, one 45 horse-power, one 25 horse-power, one 18 horse-power, two 16 horse-power, one 15 horse-power, one 6 horse-power and one 3 horse-power.

This seems to carry out the old adage that first impressions are lasting, and the company is to be congratulated upon the very favorable opinion created some years ago, since which time there have been many changes in electrical apparatus. The reputation of the company for building economical and safe apparatus has been steadily growing.

"THE BABY DYNAMO."

UNDER this appellation, the Rhode Island Telephone and Electric Company, of 24 Calender street, Providence, are putting on the market the little magneto machine of which an illustration is here shown. If the switch is thrown out of contact with the multiplying gear, the current is mild, and its



R. I. TELEPHONE AND ELECTRIC CO.'S MOTOR.

strength is greatly increased if the switch is placed in contact with the gear. The retail price of the toy is $1, and with it a great deal of innocent amusement and instruction can be secured.

FRANKLIN H. KALBFLEISCH.

Those who are installing electric plants realize more than all others the importance of having acids and chemicals that will be reliable in every instance and will give satisfactory service. Those who desire such goods we take pleasure in referring to Franklin H. Kalbfleisch Company, 54 Maiden lane and 29 and 31 Liberty street, New York, whose advertisement appears in this issue. This concern have a wide reputation among electrical workers, and in many instances their acids and chemicals are specified in estimates, etc., which proves that they have a high reputation. The president of the company is Mr. Franklin H. Kalbfleisch, the youngest son of the late Martin Kalbfleisch, formerly mayor of Brooklyn, who was the founder of the firm to which the sons succeeded, first as Martin Kalbfleisch & Sons, and afterward as Martin Kalbfleisch Sons Company. Mr. Franklin H. Kalbfleisch withdrew from the above firm in March, 1893, and was the last of the original Kalbfleisch interest to sever his connection with the then existing corporation. The success that has followed the corporation has been marked. Under the most adverse circumstances and during the period of business depression and financial difficulties unequaled, the business has grown to enormous proportions and it was found necessary in March, 1896, to enlarge its factory capacity by acquiring the plants of the Joseph Binns Chemical Company, both at Brooklyn, N. Y., and Waterbury, Conn.

The company are now among the largest manufacturers of nitric, muriatic and sulphuric (brimstone) acids in the country, besides making a full line of acids for the various storage batteries, also battery and electropoin fluids, blue vitriol, etc. A prompt reply will be received to any inquiry for quotations.

NEW RAILS FOR THE B. & O.

The new 85-pound steel rails that the receivers of the B. & O. purchased several months ago, at an exceedingly low figure, are now being delivered at the rate of 5,000 tons a month. As fast at it comes it is being laid, and if the weather continues good, at least 20,000 tons of it will be in the track by Christmas. Nearly a million cross-ties have been bought in the last year and placed in the track ready for the new rail. Ballast trains have been kept busy up and down the line and the work has progressed with such rapidity that when the new rail is down, the tracks will practically be brand new from Wheeling to Baltimore. There are lots of good rail in the old tracks, not heavy enough for the new motive power, which will be taken up and laid on divisions where traffic is not as great as it is on the main line. About 10,000 tons of new steel will be laid on the lines west of the Ohio River this fall, if weather permits.

ADVERTISERS' HINTS

WARD LEONARD ELECTRIC COMPANY have recently issued a new catalogue showing new types of rheostats, circuit breakers, etc., and including new prices. A copy will be sent on application.

WALKER COMPANY present an argument in their advertisement in favor of using 2½ watt lamps provided a steady regulation in the dynamo is secured, which will prevent the lamps from breaking easily. The use of a 2½ watt lamp instead of a 4 watt lamp will permit either a greater illumination with the same number of pounds of coal or by not increasing the number of lights will effect a saving in the coal bill.

GOUBERT MANUFACTURING COMPANY, manufacturer of the Goubert feed water heater and Stratton Separator Company, not only have their apparatus in the plant of the Charleston City Railway Company, described in this issue, but have also installed it in a number of street railway companies in various parts of the country.

DIEHL MANUFACTURING COMPANY show in their advertisement an illustration of their exhaust wheel.

ON PAGE XX. will be found several announcements offering advantageous properties for sale, and also showing apparatus desired by various advertisers.

ELECTRIC APPLIANCE COMPANY speak this week of the merit of Paranite wire.

E. G. BERNARD COMPANY have established a Western agency in the Monadnock Building, Chicago, Ill.

AMERICAN ENGINE COMPANY have recently furnished the United States War Department with an American Ball engine and a 35 kilowatt d. c. generator.

E. AND O. E. NOT O BUT E. By a slight error in our issue of August 19 the address of the Monson-Burmah Slate Company was given as Portland, Mo., instead of Portland, Me. This mistake has been corrected this week, and electrical concerns who wish to purchase slate for various electrical purposes might communicate with this company.

AMERICAN RHEOSTAT COMPANY announce that although wheat and other commodities have gone up, their prices are still the same, and that they manufacture rheostats for all purposes. They also invite prospective purchasers to write for price lists of their goods.

THE BALL ENGINE COMPANY, ERIE, PA., write: The J. S. Monken Company, Memphis, Tenn., in a letter to us ordering a crank pin box for a 60 h. p. engine, say that this is the first repair part ordered since the installation of the engine ten years ago. This substantiates our claim, which we can verify by other instances, that a well built high speed engine has as long a life with greater freedom from repairs than a slow speed engine.

NEW YORK NOTES.

EDISON MANUFACTURING COMPANY, 110 East Twenty-third street, New York, have just issued a new and exhaustive catalogue of their numerous specialties, such as Edison-Lalande batteries, Edison motors and fan outfits, Edison projecting kinetoscopes, Edison electromedical appliances, etc. This concern can special attention to their full line of Edison X-ray apparatus for battery and 110 volt direct current outfit; also combination X-ray and cautery outfit for same current. The Edison Manufacturing Company will be pleased to send their catalogue to any address upon application.

HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York, carry a large line of felts for electrical purposes and are pushing this department. They solicit correspondence from consumers of these goods, as well as in their other lines, such as tools for electrical purposes and telephone box locks.

WESTERN ELECTRIC COMPANY are now occupying their fine new factory on Bethune street, New York City, but will carry on still their retail store in the old Thames street building, where a good deal of work is also being done by this busy concern.

MR. R. F. STRAINE and Mr. C. S. Lamson, the president and treasurer of the United Telegram Company, were arrested in Boston on August 30, on a charge of conspiring to defraud the company to the amount of $73,371. The action was taken on the initiative of W. H. Baker, vice-president of the Postal Telegraph Company. Mr. Marsden J. Perry is the receiver of the United Telegram Company.

MR. J. H. ASTRUCK, manager of the Electric Arc Light Company, 687 Broadway, New York City, says: "With the return of prosperity throughout the country, we find that the electric lighting business is improving daily, and, in addition to a large amount of smaller orders, we have within the last month secured some large installations. We have just closed a contract to light the stores of Messrs. James A. Hearn & Son, of West Fourteenth street, New York City, with 135 or more 'Pioneer' lamps."

T. N. MOTLEY & CO., 43 John street, New York, have added an electrical department to their business, for all lines of work. It is in charge of Mr. Joseph Keefe, lately with the Westinghouse and Greeley companies.

A. L. BOGART have removed their business in electric gas apparatus, etc., from Union Square to 50 East Twentieth street, New York City, and are now installed in their new quarters.

BRAZING GRAPHITE.—Not a little of the expense in brazing is due to the cost of removing the brass which has stuck to the metal where it is not wanted. The removal of this brass is usually attained only by patience and diligent filing. Now comes to the aid of the brazier that unique mineral, graphite, which is not affected by acids, alkalies, heat or cold. Braziers who have made use of Dixon's Pure Flour of Graphite pronounce it worth its weight in gold. A sample will be sent without charge by the Joseph Dixon Crucible Company, Jersey City, N. J., who are the only manufacturers.

CHAS. J. BOGUE, Centre street, has added a new department to his general line of repair work. It is the manufacturing of searchlights, projectors, and as a specialty, searchlights for the tops of trolley cars; also projecting lamps for electric fountains.

WESTERN NOTES

MR. M. L. VOUGHT, of La Crosse, Wis., has recently placed upon the market an adjustable hanger for incandescent lamps, which seems to be destined to fill a long-felt want in this direction. The hanger is sold at a very low price, and is having a large sale. The United States Electrical Supply Company, of 120 Liberty street, are the Eastern sales agents.

GALE'S COMMUTATOR COMPOUND.—The price of Gale's Commutator Compound from and after September 1 will be reduced one-third. Speaking of this reduction, Mr. Isaacs, secretary of K. McLennan & Co., stated to a representative of this journal, that there would be no reduction in quantity or quality, but in price alone. There are several reasons for this reduction, he stated, chiefly the more than treble former sales. The adoption of Gale's commutator compound by nearly every electrical power plant and central station, and by a vast number of isolated plants, has more to do with the reduction than any one other cause; as, in fact, it has made possible the other reasons, that of improved new machinery and direct importation of ingredients. The latter will result in large saving, and they propose to give the users of Gale's compound the benefit of what they buy, over increased use made possible. The reduced price will prevail for all supply houses, and free sample sticks will still be furnished to the few, if any, who have not as yet tried Gale's.

MR. GODFREY G. LUTHY, of the Royal Electric Company, Peoria, Ill., made a short visit to Chicago a few days ago.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. SEPTEMBER 9, 1897. No. 488.

TELEPHONY AND TELEGRAPHY

THE HARTFORD, CONN., EXCHANGE OF THE SOUTHERN NEW ENGLAND TELEPHONE CO.

THE constant evolution and improvement in method and equipment of the telephone industry, is probably not excelled by that of any other of the great electrical enterprises. Certainly the material of no industry of like age has undergone so great a change or has been the subject of so varied and exhaustive experiment as that which was instituted upon the invention of the telephone. From the days of the "buzz-box" to the present time, when we converse, without thought of distance, with people scattered from Maine to Nebraska, capital, brains and the energy of thousands have been united in a persistent and successful endeavor to develop the science, and place it upon an efficient footing. The history of the business has been one constant, unceasing effort to develop

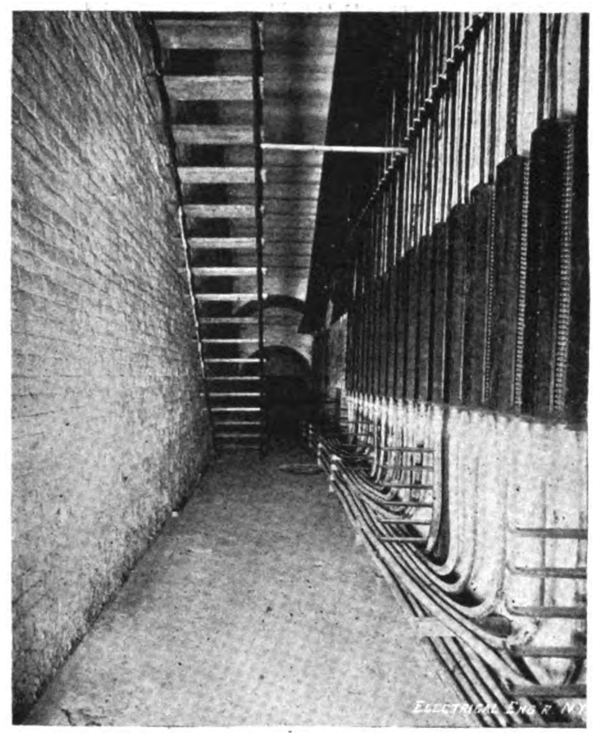
HARTFORD, CONN., TELEPHONE EXCHANGE.

and perfect. There has been no chance and no excuse for a wideawake management to get into a rut.

Among the companies which have led rather than followed, in this march of improvement, is the Southern New England Telephone Company, whose New Haven Exchange, instituted on January 28, 1878, is conceded to have been the first telephone exchange in the world. Next in size and importance to the New Haven Exchange of the Southern New England Company, ranks that located in the City of Hartford. This exchange numbers 1,200 subscribers, and has its headquarters, under the management of William H. Babcock, an old-time telegrapher, in the company's building, erected for the purpose, on Pearl street.

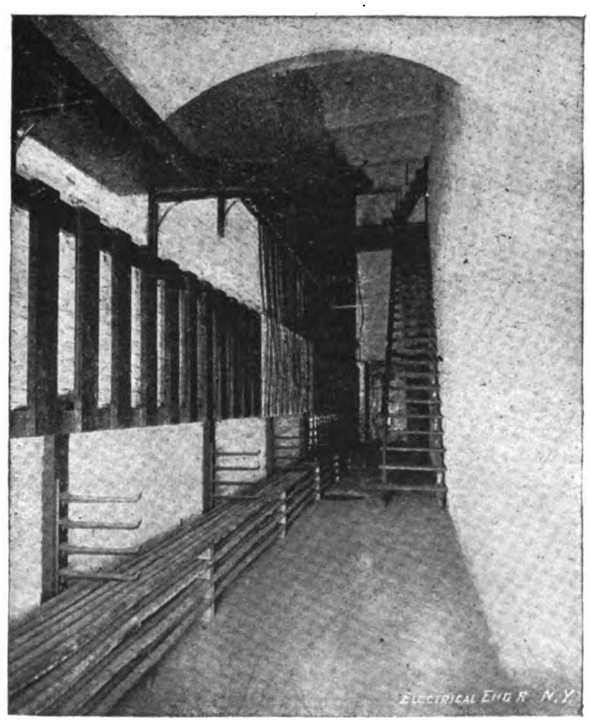
A system of underground distribution is being rapidly pushed in Hartford. At the present time it comprises 41 miles of underground duct, containing 25 miles of cable. The system in use is one originated by General Superintendent E. B. Baker, of the Southern New England Company, and is giving good results. It consists of manholes at each street corner, with regular cable ducts of 3-inch cement-lined pipe laid between them, with a distribution pipe superimposed on them. In this duct, at intervals of 25 to 50 feet, are inserted iron junction boxes, from which are run 1½-inch iron curb laterals, which terminate in curb boxes under the sidewalk. From these curb boxes, an ordinary iron gas pipe is run to a point just inside the cellar wall of the subscriber.

Service wires are run from the nearest manhole, where the regular cable ends in an okonite tip, to the subscriber's premises through the distribution duct, junction box, curb lateral



HARTFORD TELEPHONE EXCHANGE TUNNEL.—LOOKING OUTWARD.

and service pipe, one pair being used for each subscriber regardless of whether the service is single or party. The accompanying diagram gives a clear idea of the system. From the

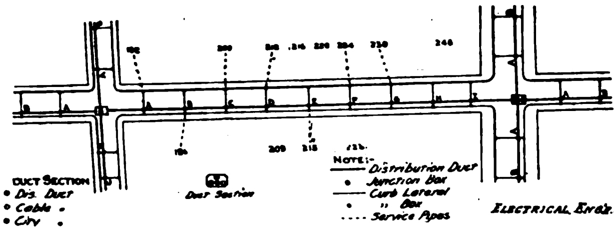


HARTFORD TELEPHONE EXCHANGE TUNNEL.—LOOKING INWARD.

office manhole, on Pearl street, the forty 52 pair cables in use enter the building. These contain 2,180 metallic circuits, the system in use all through the territory of the company. From

the front wall of the building, the tunnel, the views of which are shown on page 221, carries the cables to the terminals.

The underground cable heads in the tunnel are connected with the main distributing rack by means of rubber-covered cables. The distributing rack itself is made entirely of iron; the switchboard cables terminating on the front side and the rubber covered cables above mentioned, on the back. The



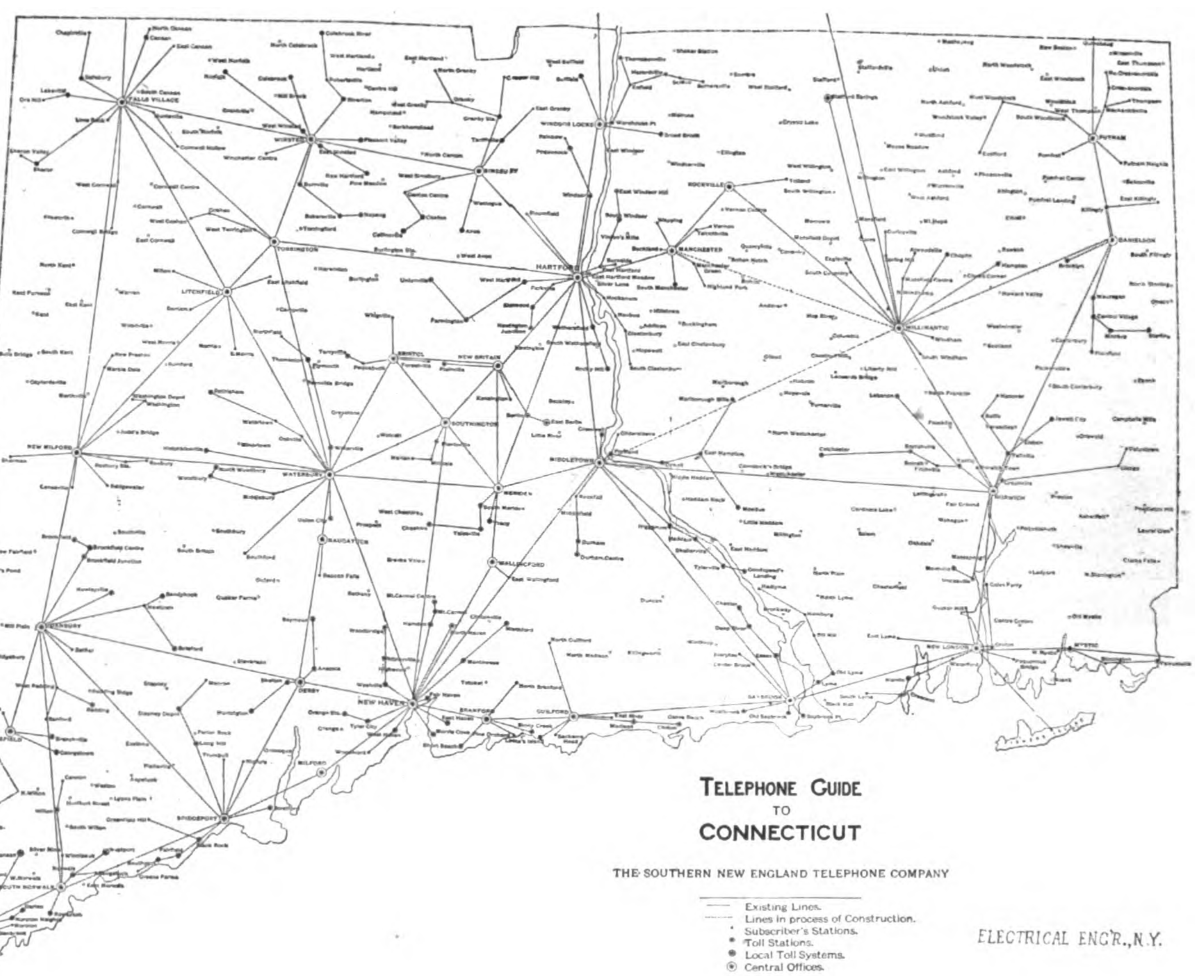
SYSTEM OF UNDERGROUND TELEPHONE LINE DISTRIBUTION, HARTFORD, CONN.

cross connecting between these cables is done with okonite wire twisted in pairs.

The protectors are mounted on the front side of the rack, and are so arranged that they are in series between the okonite wire and the switchboard cables. They consist of a carbon plate lightning arrester and a small heating coil, which, upon the passage of any abnormal current, automatically grounds

multiples through every section. It is composed of eight full sections and two one-third sections, half of it being placed on one side of the room and the balance on the other side, so that the operators sit back to back, the chief operator's desk being located midway between them. Six of these sections are equipped for two long distance, four trunk and twelve local operators; one is used for a test section and the eighth is at present unequipped. Each trunk and long distance operator's position is equipped with twenty line annunciators and ten pair of cords. The local operators' positions are each equipped for eighty lines, and the same number of cords as are on the trunk and long distance sections. There is a small electric light in front of each operator, so connected that it glows as soon as an annunciator in that position falls. Upon answering the call the operator automatically restores the drop to its normal position and extinguishes the light. She also throws a busy test upon the wire so that the other operators all know that it is in use.

The first section of the switchboard is equipped entirely with four point jacks, so arranged that when plugs are inserted in them all the rest of the switchboard is cut off. Daily tests are made at this section on all of the local wires for grounds, crosses or open circuits. This section is also used for a recording trunk operator, who receives all calls for State and Long Distance connections, finds out from the party calling the name and location of the subscriber who is wanted, and in the case of a firm or a corporation, the particular party desired. This information is all placed on a message ticket, which is turned over to the operator having under her control



MAP OF CONNECTICUT, SHOWING CITIES AND TOWNS REACHED BY LINES OF THE SOUTHERN NEW ENGLAND TELEPHONE COMPANY.

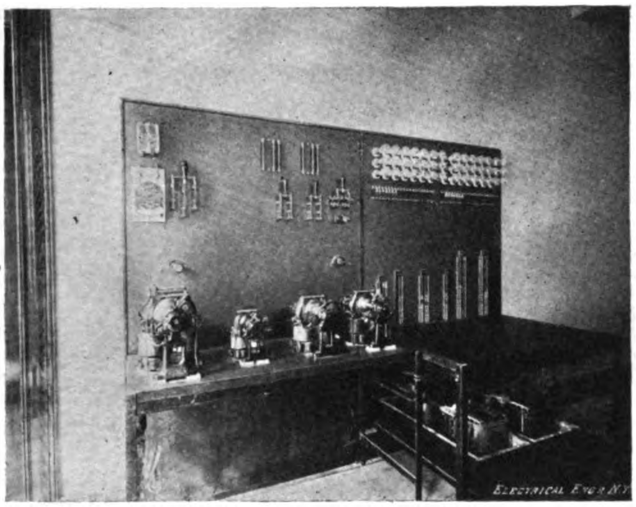
the wire and in this way cuts off the switchboard. These heating coils also act in connection with the fuses at the further end of the underground cables; that is, when they ground a wire at the central office they put a practical short circuit on it, and the rush of current which immediately follows blows the fuse at the cable terminal and so opens the wire.

The local switchboard was manufactured by the Western Electric Company. It is of the bridging metallic type with self-restoring drops, and is so arranged that each local wire

the circuits which reach the exchange desired. She, from this information gets the party wanted, and when he is reached calls the subscriber and makes the necessary connection.

All the trunk wires pass from the cross connecting rack directly to an independent trunk test-board located back of the chief operator's desk. This test board consists of a combination telegraph peg switchboard and telephone looping-in and terminal jacks. Each trunk wire passes through two of these looping-in jacks, then through the metal strip on the

peg switchboard and from there to a terminal jack where they are left open. The peg switchboard and looping-in jacks are used for testing the wires, that is, they are so arranged that any of the various test batteries may be thrown on any wire and a Morse relay and key looped in on the circuit. Each annunciator on the telephone trunk switchboard is connected with two flexible cords on the test-board, these cords termin-



Hartford Telephone Exchange.—Power Switchboard and Generators.

ating in single plugs. By means of this arrangement any pair of trunk wires can be thrown into any one of the trunk operator's positions, and in the case of a breakdown the wires can be made up in any way desired by the chief operator without his being obliged to go anywhere near the telephone switchboard.

The power-board is built entirely of slate and iron and is equipped with four Crocker-Wheeler dynamotors. Two of these machines are so wound that they give on the secondary side a 75-volt alternating current; one of them is used for ringing subscribers' bells and the other is a relief machine for the same purpose. The third machine gives a 110-volt direct current on the secondary side, which is used for Morse

Hartford Telephone Exchange Switchboard.

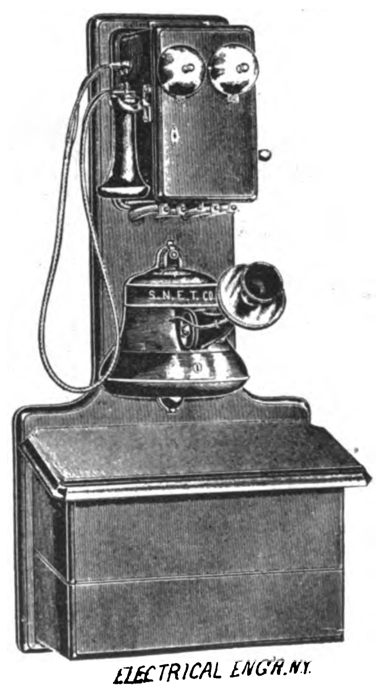
work or for testing as is necessary. The fourth machine gives a 6-volt direct current which is used for charging four cells of storage battery. From these four cells is drawn the current for all the operators' transmitters, the busy test, restoring the drops and lighting the lamps above mentioned. They are so arranged that they are always in circuit. The charging is done whenever necessary.

In connection with their telephone service the Southern New England Telephone Company have introduced Watchman and Standard time systems. The former is designed to give banks and factories a better hold upon their night watchmen than is furnished by the ordinary watchman's clock. It consists of an open circuit district box located at the subscriber's station; one side of this box is connected with the ground and the other side is connected to one side of their telephone circuit. The same side of the telephone circuit passes through a switch at the telephone exchange, so that a Morse relay and grounded battery can be tapped onto it. The local points of this relay pass through a Game-

Hartford Telephone Exchange Switchboard.

well fire alarm register and time stamp. This register records automatically on a paper tape the number of the calling box and the time the call is received. In case a watchman does not send in his call at the proper time it shows positively that he is either not attending to his duties or is detained from doing so. In either case the police are notified by telephone by the person in the exchange who has this system under his supervision, and they look the matter up.

The Baker standard time system consists of self-winding clocks located in the subscribers' stations, which are syn-



Subscriber's Telephone Set.

chronized every twelve hours by time signals received from the Yale College observatory in New Haven. These clocks are connected with the telephone circuit at the subscribers' stations and the telephone wire is used to send the impulses of current which synchronize them.

The clocks are so arranged that the telephone circuit is grounded through the synchronizing magnets for about three minutes every twelve hours; one and one-half minutes before

and one and one-half minutes after the even hour. During this period, at exactly the even hour, an impulse from a grounded battery is thrown on the telephone circuit by the master clock. This battery energizes the synchronizing magnets and sets the clock if it is either fast or slow. The clock is synchronized at hours when the telephone circuit is not liable to be in use for telephonic messages, for instance, at 7 a. m., and 7 p. m., although even if the subscriber does happen to be talking at the time, there is no practical interference to the telephone service.

ELECTRIC LIGHTING

THE CROYDON, ENGLAND, ELECTRIC LIGHT PLANT.

THE electric lighting of the town of Croydon, England, practically a populous suburb of London, is vested in the hands of the municipality, but in the operation of the plant an ingenious, though temporary, method of compromise has been adopted, interesting in its novelty, and unique in that it differs from any other case known to us of municipal ownership of an electrical lighting plant. In the system of severation and distribution there is also considerable that is novel.

The funds for the erection of the station and the underground supply system were all provided by the corporation, which purchased the plant in its entirety from the British Thomson-Houston Company, Limited. This latter company agreed to operate the plant for ten years, paying to the town authorities 3 per cent. interest on the investment, and contributing a certain annual per cent. to the sinking fund. On the other hand, the British Thomson-Houston Company exploits the system and collects all revenue from the sale of light and power, etc. The agreement stipulates that at the end of ten years the installation shall revert to the municipality. This period may be shortened on six months' notice to the company, and the payment of an indemnity calculated on a basis previously agreed to.

The system of generation is high tension alternating at 2,000 volts for the incandescent lighting; this is directly transformed down in substations. For the arc lighting rectified

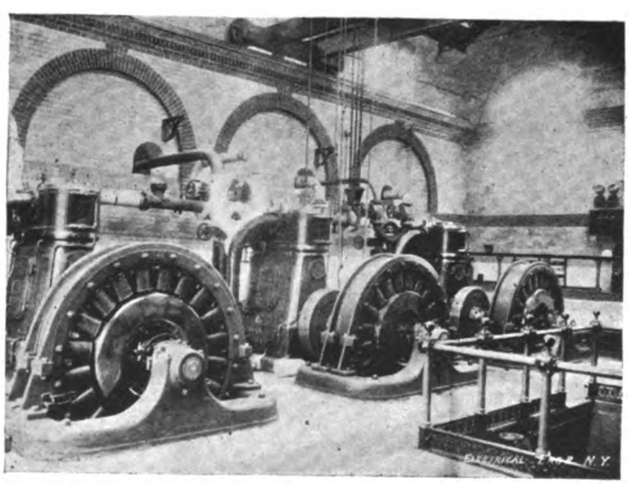


Fig. 1.—Dynamo Room, Croydon, Eng., Electric Light Plant.

alternating current is used. During the evening current is furnished from the main alternators; during the daytime from a smaller alternator driven by a continuous current motor operated from a storage battery, charged during the evening by the same combination, the position and operation of the two machines, however, being reversed. By the adoption of this method a direct and noticeable economy is effected. The services of boiler, engine and alternator as well as that of the necessary workmen and attendants during the day are dispensed with. For so small a demand as at present exists for daylight current, the charges for this extra service would be very heavy, but by the unique method adopted a single attendant suffices to look after the station during the day, and to keep watch over the small generator group and the battery.

This is the first instance in which this system has been followed, and its simplicity is such that, in England especially, the example is likely to be extensively followed, in cases where the day load is not sufficiently great to warrant the operation of an entire steam and electrical group.

The central station outside the town is a brick building,

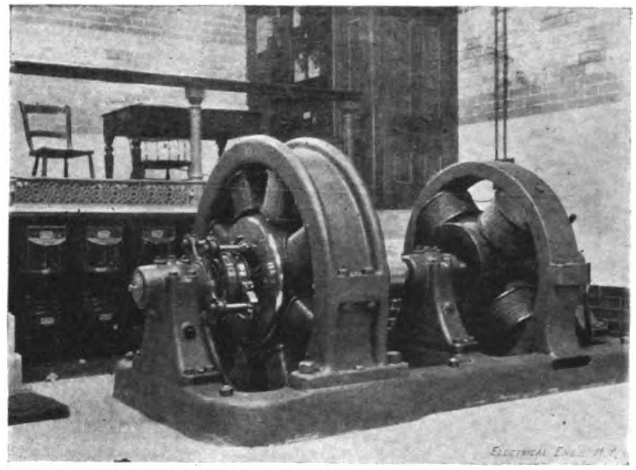


Fig. 2.—Combination Set, Croydon Electric Light Plant.

containing boiler room, engine room and battery room and offices. The boiler room contains three multitubular boilers, each of 300 horse-power capacity at 160 pounds pressure; two Worthington pumps and a Green economizer. All the steam piping is in duplicate to avoid shut down in case of accident. The three engines illustrated in Fig. 1, are of the Belliss compound vertical type, each with a capacity of 240 horse-power, at a speed of 300 revolutions per minute. Each engine is provided with a special governor which allows the load to vary from full to no load, without increasing the speed more than five revolutions per minute. To each engine connected by a special clutch is a Thomson-Houston alternator especially designed to meet the conditions of this installation. The machines are 20-pole 60-period alternators, the armatures of which carry each coil in an independent slot in the core, so that in case of injury to any coil it is confined to that coil and does not affect its neighbors. As the coils are wound in forms before placing in the case, injured ones can readily be removed in case of accident and be replaced by new ones. Of the collector rings and brushes, one set is thoroughly insulated, while the other is connected to the earth. The insulated ring and brush are under a glass cover to prevent accidental contact. Each alternator is rated at 120 kilowatts at 2,000 volts.

For the services of the station during the day the motor generator group, above referred to and shown in Fig. 2, is called into requisition. The group consists of a shunt-wound direct-current motor, directly coupled to a 30 kilowatt alternator. The motor during the night becomes a generator, driven by the alternator as a synchronous motor, and furnishing current to the storage battery. During the day this action is reversed; the direct current machine again becomes a motor, taking its driving current from the storage battery, and drives the alternator which reverts to its original purpose as a generator. The storage battery is divided into two parts, each consisting of 60 cells, occupying a room to itself adjoining the engine room. Its current not only drives the combination just mentioned, but also furnishes the exciting current to the main alternators. The cells are charged at 160 volts and discharged at 120 volts. A 3-volt dynamo, driven by a small motor, is used in the treatment of any "sick" plates in the battery.

The main switchboard in the station is simple in character. As the exterior conductor of the concentric cable used is connected to the earth, both switches and cut-outs are single pole. A Thomson recording wattmeter is in circuit with each alternator and Kelvin station instruments are used.

The substations are four in number, each connected to the station by independent feeders, but interconnected also by high tension cables. Each feeder supplies its own portion of the system, but at the junction points are placed boxes, which allow any section to be connected to its neighbor in case of accident to any substation. Three of the substations are in small

brick houses; the fourth is underground in a well cemented and well ventilated chamber.

Each substation contains the transformers and two switchboards, one for the feeders and distribution switches, the other for the interconnecting switches and distributing mains. All the lines are fully protected by circuit breakers and fuses. The mains are all laid underground, and all cables used are concentric. The secondary distribution is made at 200 volts.

The purely municipal lighting is effected with 43 T.-H. arc lamps, 20 of which operate until midnight only, while 23 burn for eighteen hours.

THE METERS OF TO-DAY.[1]

BY R. F. SCHUCHARDT.

MR. GEORGE H. JONES, of Fond du Lac, and myself have just completed a thesis on American electricity meters under Prof. D. C. Jackson, at the University of Wisconsin. The meters tested were the Thomson, Duncan, Shallenberger and Schaeffer.

The results obtained in our investigations show that the meters of the present day are not all that might be desired, and central station men, who know that the bills of customers using approximately equal amounts of light often vary to a great extent, and who continually have complaints of overcharges made to their companies, will bear me out in this. It is of the utmost importance that central station men test each meter they install. Many managers are beginning to realize the importance of this subject, and have added meter-testing departments to their stations, where all meters are tested before they are installed. After they are once installed they should be inspected every six months or so, in order to see that they are working properly. This is hardly ever done at present.

The curves of the tests illustrate very clearly the action of these meters. Our method of calculating the error of the meter may be of interest. The speed of the meter is directly proportional to the load; therefore, for a given load the product of seconds per revolution of the armature and amperes (in ampere-hour meters), or watts (for watt-hour meters), equals a constant (which we call K), which varies with the make and size of meter. As will be seen this K is the time in seconds which it takes for the armature to make one complete revolution per unit of load (ampere or watt).

The product of the observed load and seconds per revolution divided by this K, $\frac{\text{amp. x sec.}}{\text{K}}$, or $\frac{\text{watts x sec.}}{\text{K}}$, should then equal unity for an accurate meter and the variation from unity will give directly the error. Should this quotient be more than unity, the meter runs too slowly on that load; and if less than unity, the error will be negative, which means that the meter is running too fast.

Thus, let the time per revolution be 4 seconds for a load of 440 watts on a 10-ampere, 100-volt Thomson wattmeter. The value of K for this meter is 1,800; then, $\frac{4 \times 440}{1,800} = .973$, which shows that the meter runs 2.2 per cent. too fast on that load. Or, let the time per revolution of the armature be 2 seconds for 3.3 amperes on a 20-ampere Shallenberger ampere-hour meter in which the value of K is 6.33; then $\frac{2 \times 3.3}{6.33}$ The meter is, therefore, 4.2 per cent. slow on that load.

The curves show that the action of the meters is very irregular, but their general behavior is clearly shown.

We found our samples of the Duncan watt-hour meters to run too fast, but by properly adjusting the magnets, their error could be brought within the limits of about 5 per cent. either side. Both of the Duncan ampere-hour meters tested started much too slowly and were also much too slow on the high loads. The effect of frequency is very marked, the difference in error at full load between frequencies of 60 and 130 being about 30 per cent.

After starting load, the Schaeffer wattmeter ran with a small and fairly uniform error. These meters are designed for frequencies, and when built for two frequencies are provided with a special German silver resistance in the pressure circuit to compensate for the difference. One of the meters tested by us, built for frequencies of 60 and 130, ran with an average difference of about 6 per cent. between these frequencies.

All of the new Thomson wattmeters started on no load, while the old ones started much too slowly. Their curve of error is a remarkably straight line after starting load. They are, of course, independent of frequency.

The Shallenberger ampere-hour meters started much too slowly. One of the three tested ran fairly uniform after starting, while the other two were too slow on high loads. The higher frequency makes them run from 5 to 15 per cent. faster.

The Shallenberger watt-hour meter was found to be very fair. It started on a very light load, ran without any great error, and responded promptly to changes of load. Frequency has no appreciable effect.

All of the meters tested are practically unaffected by the changes of pressure likely to occur in service. The Diamond wattmeter should not be used with inductive load, as the effect of such load is very marked, making the meter run much too slowly, and with a power factor low enough it stops entirely and even runs backward.

Besides these meters tested in the laboratory, we were enabled, through the courtesy of the Madison Gas and Electric Company, to test meters in actual service. The general results of this test indicate that the ampere-hour meters require a comparatively large current to start them; run much too slowly on starting load and on the higher loads. Most all of them have considerable error on overloads. The wattmeters are somewhat better, and as a rule run too fast on all loads except at starting and with a fairly uniform error. The Thomson meters show the least variation in error, but the continuous watts absorbed are more than in any of the others.

A fact of great importance brought out in this test is the lack of proper attention paid to the installation of the meter. In many cases the meters are placed on door frames where they are continually jarred. They should be installed by securely fastening them to a firm wall in a readily accessible dry place and well leveled. The meters should all be carefully sealed to prevent being tampered with. The seal should bear the private mark of the company, so any unauthorized inspection of the meter can be detected. The meter is a delicate piece of apparatus and should be carefully handled when being placed in position so as not to injure it.

After it is installed, it should be tested to be sure it is running correctly. Spiders and insects in general are very fond of the warm meters, and have many times helped to reduce the consumer's bill. The meter should, therefore, be dust-proof and be regularly inspected.

[1]Read before the Northwestern Elec. Assoc. Abstract.

MORE MONEY DESIRED FOR THE JACKSONVILLE, FLA. PLANT.

Chief Engineer John T. Parry, of the Jacksonville, Fla., city electric light plant, is agitating the question of the enlargement of the plant, and says: "I do not see how we expect to get along at all this winter with the present capacity. As it is we are trying to do too much business with our facilities. It is now of the greatest importance that the plant should be enlarged to a considerable extent.

"First, the building—especially at the west end—will have to be made larger by twenty or thirty feet in two directions. Another dynamo will have to be provided, and a third engine will become necessary. It will be difficult to add these impovements, and it will cost something in the neighborhood of $25,000 or $30,000 at the inside.

"The plant has always been a paying investment, not only to the city, but to the taxpayer and to the person burning the lights. In my opinion, taking in its value to the citizens, this plant has paid the total interest on the entire indebtedness incurred by bonding the city. It may not be shown in figures, in an estimation of the worth in dollars and cents, but in true benefit arising, first, from municipal ownership of a modern and complete plant, and, secondly, from the actual saving in cash by reducing the price of electric lighting of residences and places of business.

"It would be a capital idea to enlarge the plant so as to render the lights now in service of more benefit to the user. They are dim because of lack of current. It would also be a fine idea to put in a dynamo that could be run during the day for power purposes, and the entire extension would pay for itself.

"The city treasury seems to be wanting in funds, but sooner or later some provision for the increase so much needed will have to be made. As well have no municipal plant, if we cannot have one with sufficient capacity to accommodate the entire people if they want electric lights or power, and if they are willing to pay for them. A limited supply now does not meet the demands of the taxpayers, and these is some dissatisfaction—not with the quality but with the quantity."

ELECTRIC TRANSPORTATION

ELECTRICITY ON THE METROPOLITAN STREET RAILWAY IN KANSAS CITY.

BY JACQUE L. MORGAN

IN spite of the general business depression which has been so prevalent throughout the country, there has been expended in the two Kansas Cities in the past year for additions and improvements in street railways, about one million dollars. Transportation for the quarter million inhabitants of these cities is furnished by twenty-two street railway lines, twenty of which are owned and operated by the Metropolitan Street Railway Company, comprising nine cable, nine electric and two mule lines. The latter two roads are to be changed to trolley roads at once and the change will signal the final emancipation of this city from "black smoke" electromotive force."

The railroad company have made many improvements, a new line has been built, horse car lines transformed to trolley lines, tracks relaid and the entire system, cable and electric, incorporated into one net by the Falk cast joint. But by far the most interesting of all the improvements is the new central power house and its system of power distribution for the operation of electric and cable roads. This plant operates daily seventy-seven cars over fifty-five miles of trolley road, and ten cable trains over four and one-half miles of road.

The power house is located centrally with reference to distribution, on the west bank of the Kansas River, in Kansas City, Kan. The building is of brick and stone, with slate roof supported by steel girders. Its dimensions are 144 feet by 114 feet wide. It is divided into two rooms running the length of the building. One of these, the boiler room, is 51 feet wide and the other, the engine room, is 63 feet wide. In this room there is a 30-ton traveling electric crane, installed by the Brown Hoisting and Conveying Machine Company, of Cleveland, Ohio. This crane spans the room and runs the entire length of the building.

The boiler room contains six 250 h. p. Babcock & Wilcox boilers of the latest design and capable of carrying 200 pounds pressure. Provision for 1,600 additional horse-power has been made. The boilers are equipped with chain grate stokers, fed by gravity from a 1,000-ton coal hopper overhead, making the firing almost automatic and smokeless.

The economical handling of the fuel supply and of the ashes is deserving of special attention. From the car in the unloading shed the coal is shoveled by hand into receiving hoppers; then a conveyor carries it under the boiler room floor to the end elevator; thence to the coal hoppers overhead, where a horizontal conveyor distributes it throughout its length. The conveyor also carries the ashes from the ashpits into hoppers, where it is drawn by gravity into receiving cars.

In the engine room is a direct connected generator set of 2,000 h. p., with provisions for three similar sets, making a total of 8,000 h. p.

The engine is a Reynolds-Corliss compound condensing with

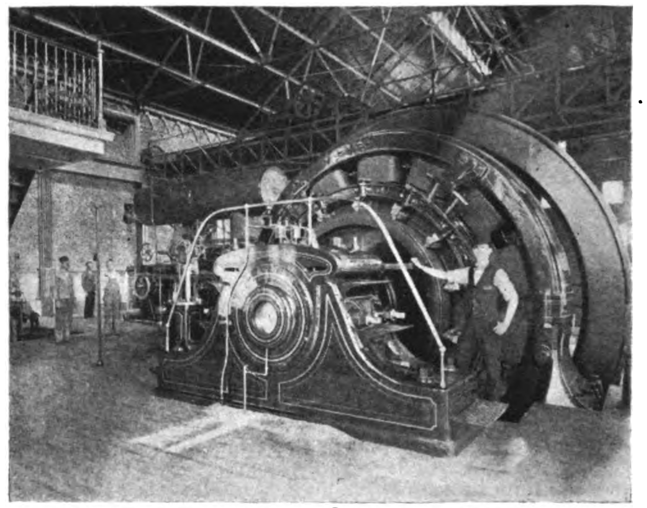


FIG. 1.—1,500 K. W. WALKER RAILWAY GENERATOR, KANSAS CITY RAILWAY CO.

cylinders 30 inches and 60 inches by 48 inches stroke. The flywheel is 20 feet in diameter and weighs 120,000 pounds. This revolves eighty times a minute on a 24-inch shaft. The engine is provided with a special governor, which is set five revolutions above speed. This effectually prevents the engine racing and wrecking itself and the building.

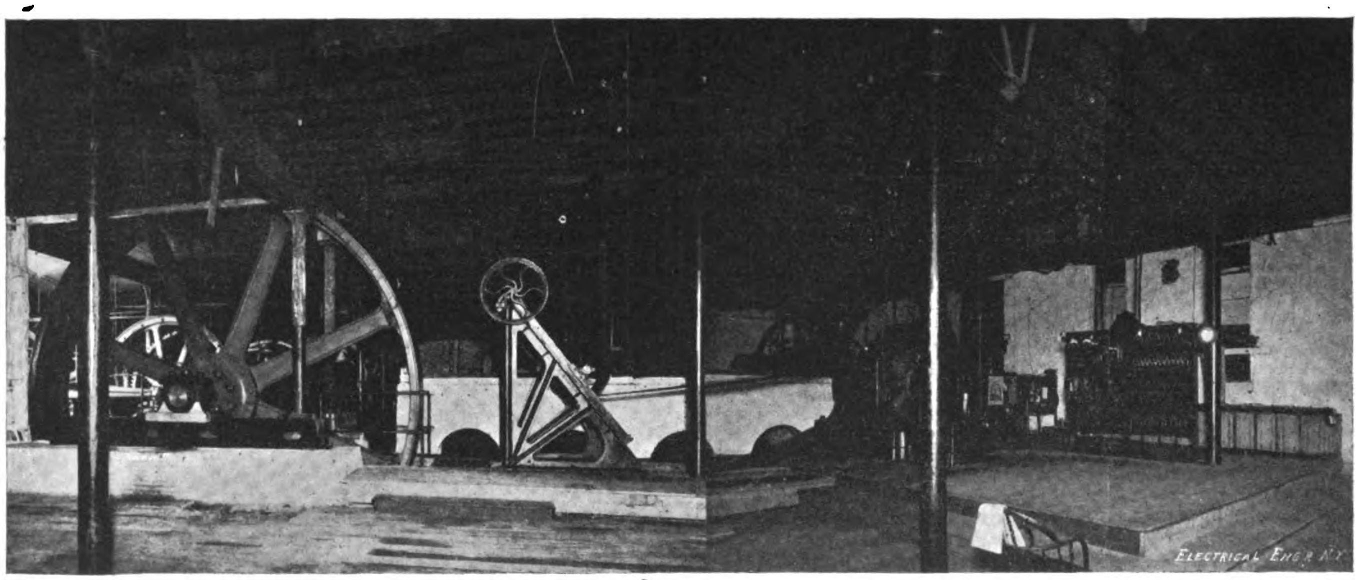


FIG. 2.—ELECTRIC MOTOR DRIVING CABLE MACHINERY, METROPOLITAN STREET RAILWAY, KANSAS CITY.

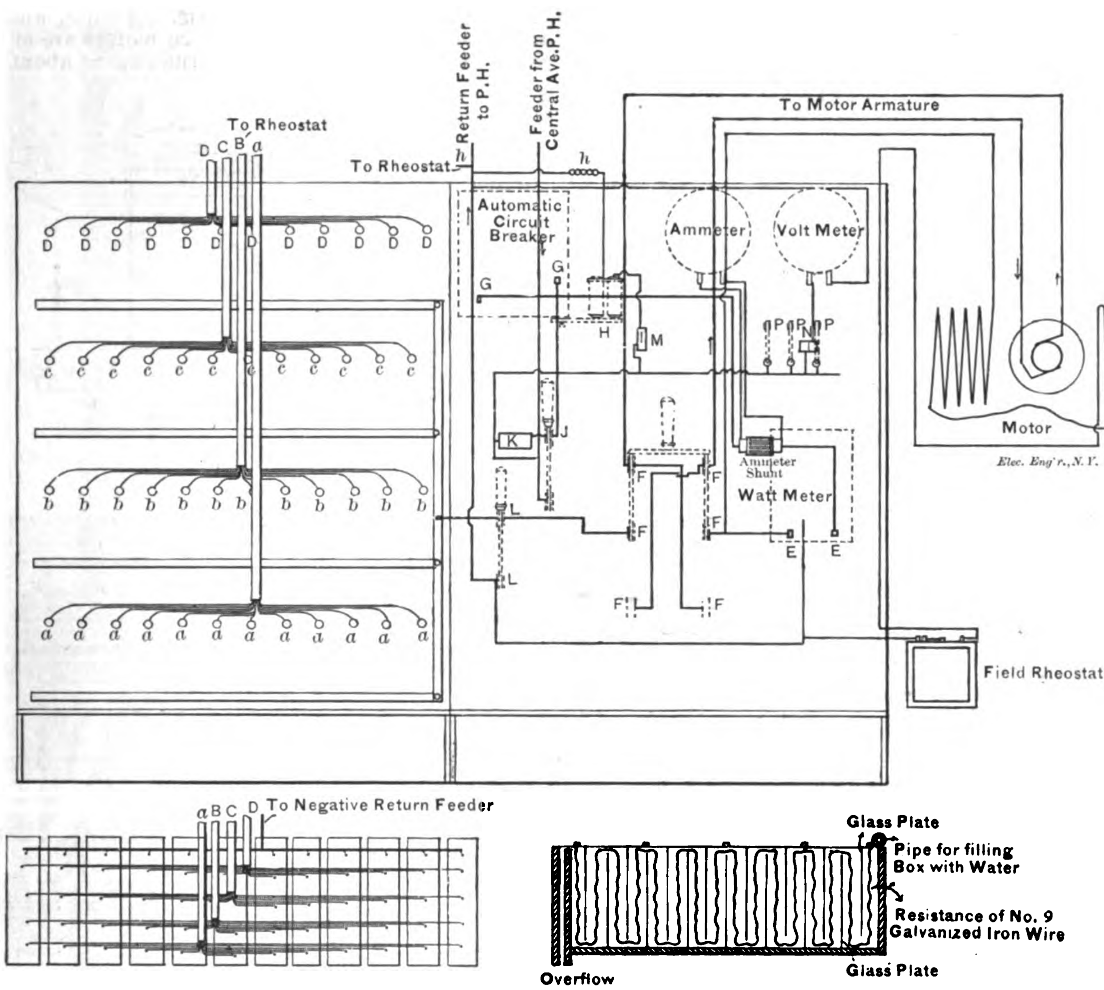
The generator, Fig. 1, is a fourteen pole, 1,500 k. w. Walker machine, and its 10½-foot armature is capable of inducing a current of 2,730 amperes at an e. m. f. of 550 volts. This dynamo is guaranteed to run at 50 per cent. overload for five hours. Up to the present time it has given great satisfaction, and although heavily overloaded not a spark of any character has been seen on the commutator.

From the dynamo three 800,000 cm. cables convey the current to the switchboard and through an 8,000 ampere Thomson recording wattmeter. The switchboard consists of two generator panels and twenty feeder panels. The switchboard is of the G. E. type and is in two tiers of polished slate panels. Weston instruments are in place on both generator and feeder panels. Each feeder panel has a shunt amperemeter, circuit breaker, quick break switch, and wattmeters will soon be placed.

The feeders running from the power house to the various lines, one of them 28,300 feet long, range from 300,000 to 1,000,000 cm. in area.

A one-million cm. circuit carries the current, a distance of about one and one-half miles, to the Washington street power house. Here a T.-H. dynamo, now doing duty as a motor, operates the Summit street cable line, and, although the amperemeter registers as high as 900 amperes, the sparking is very small. Our engraving, Fig. 2, shows a view of this motor driving the cable drum. A 36-inch belt from the armature pulley to a 24-foot flywheel operates the cable machinery, and up to the present time has displaced the engines to the entire satisfaction of the company.

The rheostat to operate such a heavy motor is a novel affair designed by the chief electrician, Mr. Charles Grover. It consists of twelve multiple coils of No. 9 iron wire, each having three points of commutation. These coils are immersed in a tank of running water. Glass plates at intervals prevent electrolytic action, otherwise the wire would last but a short time. The rheostat is on the negative side of the motor to eliminate the possibility of grounds. The diagram, Fig. 3, shows the connections for controlling the motor and the armature rheostat. The letters refer to the following details: J J, positive switch terminals; G G, automatic circuit breaker terminals; E E, Thomson recording wattmeter terminals; FF, FF, etc., reversing switches; A, A, A, are switches making connection with the rheostat; they are worked in parallel and separately. Each switch gives 50 amperes to the motor until the motor starts to move. B, B; C, C; D, D, are switches which are operated simultaneously and cut out one-quarter, one-half and three-quarters of each of the resistance boxes, respectively. The negative switch, L L, when closed, cuts out all of the resistance. The rubber-covered cables, a, b, c and d, lead from the switchboard to the rheostat.



SECTION OF RESISTANCE BOX

FIG. 3.—SWITCHBOARD WIRING FOR MOTOR DRIVING, 9TH AND WASHINGTON STREET CABLE MACHINERY, KANSAS CITY.

JOHNSON STEEL COMPANY, through its president, Mr. A. J. Moxham, has received an order for 20,000 tons of steel rail for electric railway work in Ireland. The freight rate will be $3 per ton.

ELECTRIC CABS IN LONDON.

A special dispatch from London, of August 23, says: The electric cabs that were introduced a few days ago on the streets of London are in great demand. Only two of them are plying for hire, the others having been privately pre-engaged for $5.50 a day. The company owning the vehicles say that they could let hundreds of them if they possessed them. They hope to add three new ones weekly.

A LONG TROLLEY LINE IN OHIO.

Monaghan and Jonathan Head, of Niles, two members of the new East Liverpool, Fredeickstown & Lisbon Electric Railway Company, have bought options on property leading into the city and began negotiations for a terminal at East Liverpool. The company is to build an electric passenger and freight line 29 miles long from that city, connecting with the Erie and Baltimore & Ohio systems at Lisbon and Niles. The right of way is secured. The line follows the old Beaver canal route from Lisbon to the mouth of the Little Beaver. Grading will begin, it is announced, in six weeks. The new road will be equipped with heavy motors, which will haul a good-sized freight train. The company is capitalized at $500,000. Some stock is held in Cleveland.

ELECTRICITY ON THE HARTFORD THIRD RAIL ROAD.

Experiments on the New York, New Haven & Hartford road are said to have shown that the average passenger train on a steam railroad can be duplicated on an electric line with a saving of $5,000 per train. In addition to this saving on the rolling stock, the increased earnings of the roads thus operated are to be counted. Over a distance of nine miles eight trains a day were run under the steam system, with an average daily sale of 400 tickets at 23 cents each, making a total day's earnings of $92. Under the electric system there are 36 trains a day, with a sale of 4,627 tickets at 10 cents each, making a total of $462, or five times the income from the steam service.

TWO-AXLE ELECTRIC LOCOMOTIVE FOR MIXED SERVICE.

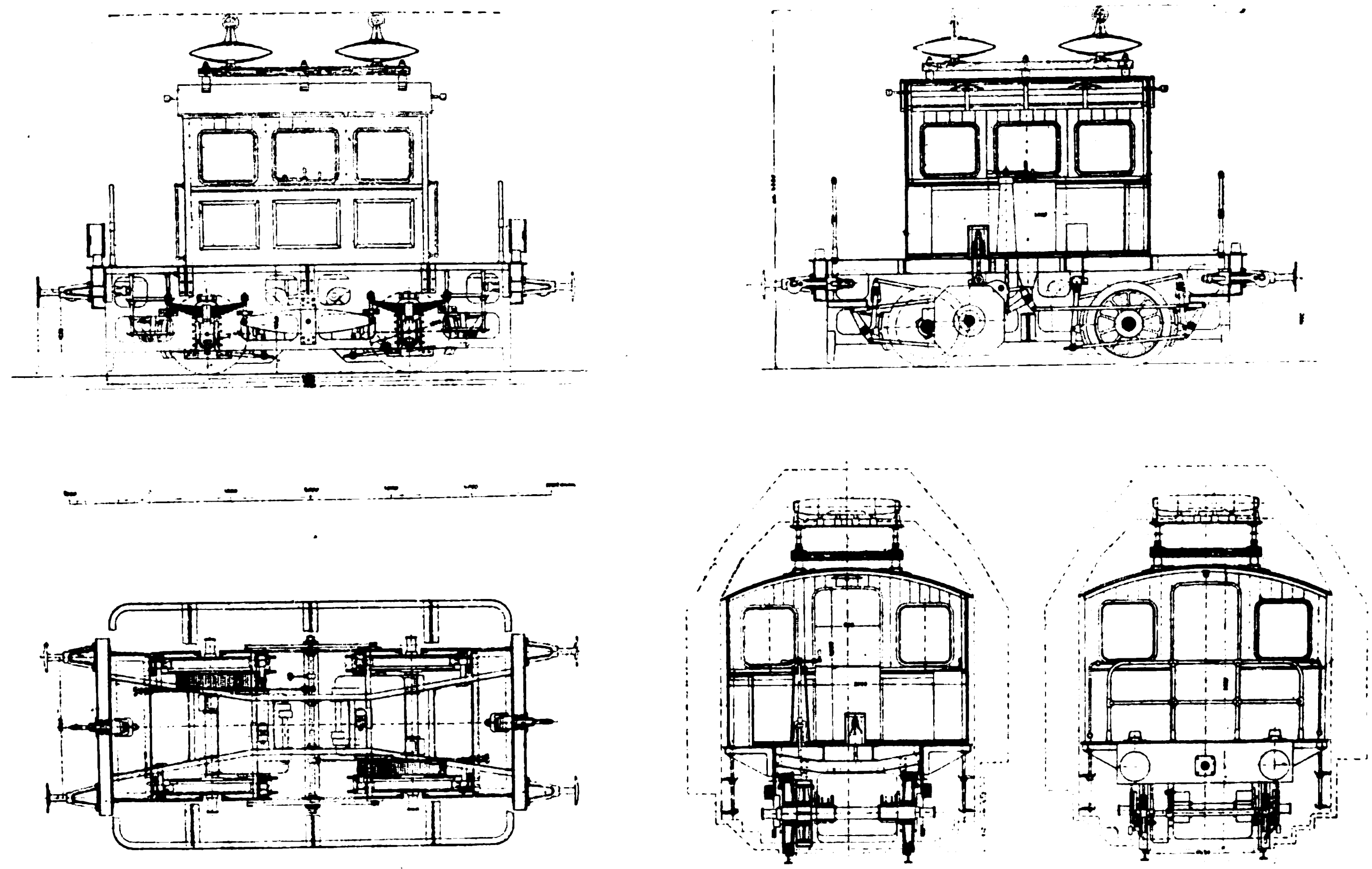
THE locomotive illustrated in the accompanying engravings has been designed by the Allgemeine Elektricitäts-Gesellschaft, of Berlin, for both freight and passenger service, and can also be used for switching. It is designed for 1,432 millimetre gauge, and built perfectly symmetrical. The locomotive has two axles, each driven by a motor, and is designed for the standard Prussian State railway requirements. The locomotive is capable of hauling a train of 120,000 kg. at a speed of 50 km. per hour on a level. For this purpose the traction weight must be about 20,000 kg. In order to accomplish this ballast boxes are provided, filled with sand or other ballast.

The Truck.—The construction of the truck is shown in the accompanying engraving. For the connection of the locomotive with the cars there is a hook with a coupling, and a safety coupling. The drawbar for constructive reasons is not carried out in full, hence every coupling hook must be inserted into the buffer with a special spring. The whole truck is covered with corrugated iron, which adds considerably to its stiffness. The wheelbase is 2,500 millimetres, so that the locomotive can take the shortest curves, and the wheels have a diameter of 1 metre. The weight of the locomotive is transmitted to the journals by means of oval springs, consisting of ribbed steel sheets 90 millimetres wide, and 13 millimetres thick; and an equalizing bar distributes the weight evenly.

The Locomotive Cab.—The cab of the locomotive is entirely enclosed and provided with windows. It is 3 metres wide, so that the motorman can have a full view of the whole train. In order to secure more perfect insulation the upper half of the cab is built of wood. On the walls below the windows are placed the ballast boxes mentioned above and tool lockers. Signaling is effected by means of a whistle, operated by compressed air, furnished by a small hand pump. Should the locomotive be supplied with automatic compressed air brakes, the whistle can be operated from this source.

Electrical Arrangement.—The current is taken off from the overhead conductor by means of two bronze rollers attached to the roof which rollers rest on the springs which press upward vertically against the conductor. This construction was adopted in place of the usual trolley wheel in order to avoid the troubles which would arise with the frequent reversal of direction of the car, and in order also to obviate the necessity of overhead switches. In order to obtain sufficient surface contact between the overhead conductor and the contact device flexible, that is to say, thin wires had to be employed. For this reason the overhead circuit consists of two hard drawn copper wires, 8 millimetres in diameter, placed 150 millimetres apart, but not insulated from each other. The trolley wires are suspended from special suspending wires, so that their lowest point is 4,430 millimetres above the top of the rail.

The locomotive has two motors; one end of each is supported on the axle and the other end suspended by a spring from the truck in such a way that only about one-eighth of the weight of the motor rests upon the axle. The gear wheels transmit the motion to the axle in the ratio of one to three. The pinion keyed to the armature, is of phosphor bronze, and the split gear of the axle is of cast steel. The motors are of the usual enclosed waterproof construction, running at about 840 revolutions per minute, at 500 volts. The regulation is effected by means of a series parallel controller. The normal current at 500 volts is 110 amperes for each motor, each of which has a capacity of 84 h. p., with a maximum capacity of 150 h. p. each. The usual safety appliances to guard against overload, lightning, etc., are provided.



ELECTRICAL ENG'R. N.Y

ELECTRIC LOCOMOTIVE DESIGNED FOR TRUNK LINE TRAFFIC ON GERMAN STATE RAILWAYS, BY THE ALLGEMEINE ELEKTRICITAET GESELLSCHAFT, BERLIN.

THE QUALITY OF TROLLEY OPPOSITION.

The greatest opposition to the construction of the Portsmouth, N. H., and York electric railroad came from a number of citizens at York Harbor, and among the passengers on the first car was the man who contributed the most cash to fight the road. A citizen of Kittery, who advertised his house for sale because the line was built, has been the best customer the road has had so far. A conductor on one of the cars relates a good story about a family who wished that the line would never be built. On Sunday last this same family were taking a pleasure ride over the route, and when the car arrived in front of their residence one of the ladies politely asked the conductor to hold the car while she went into the house to change her hat.

LAMB ELECTRIC CABLEWAY FOR A GERMAN CANAL.

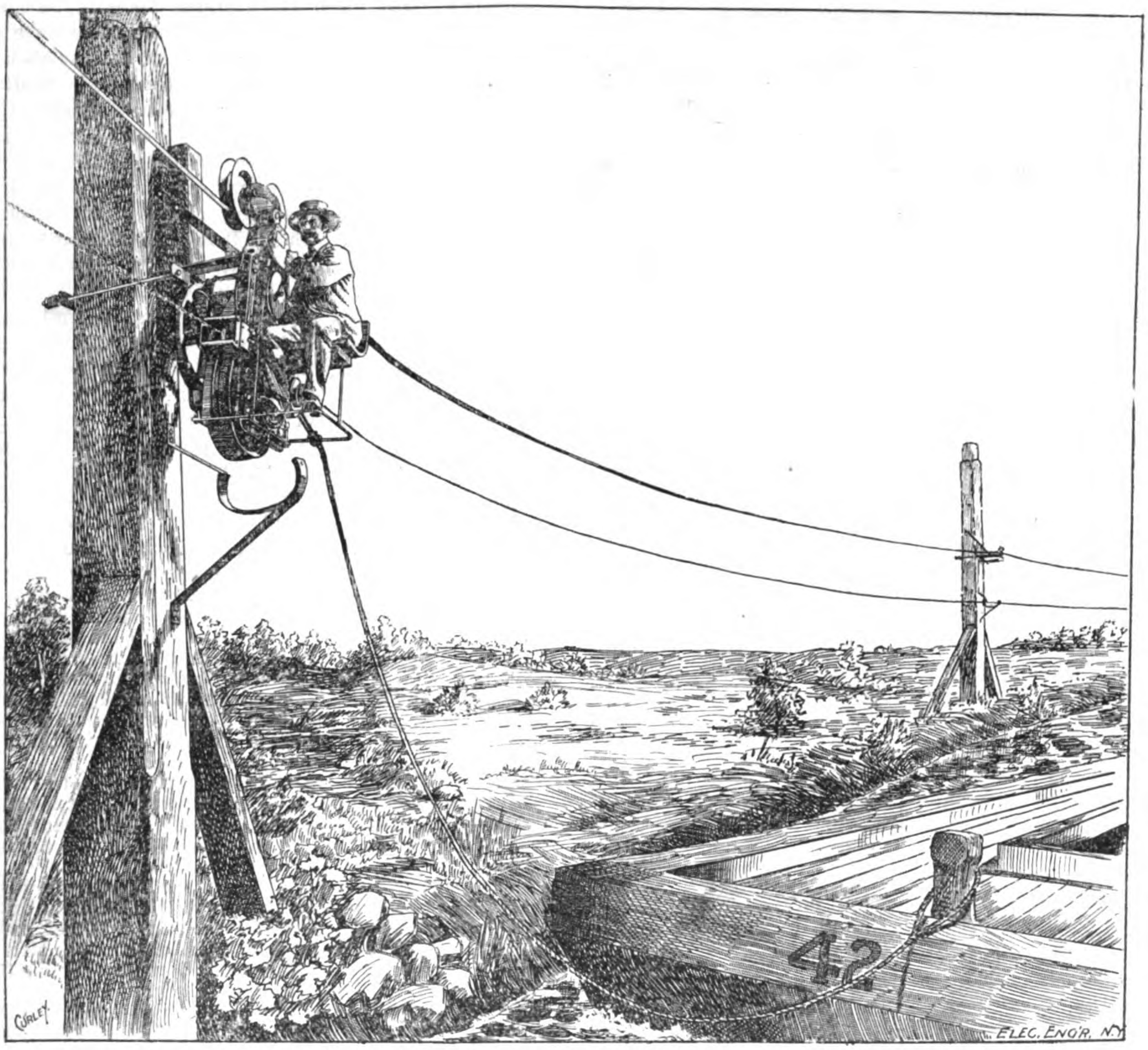
SINCE the trial of towing canal boats by the Lamb electric cableway, Mr. Lamb, in connection with the Trenton Iron Company, has been busy in improving his motor and line details, to meet the special conditions that towing canal boats present.

The test at Tonawanda, N. Y., was in every way a success. Mr. Barnes, the expert for the State, summed up his report by stating: "This electric towing system presents so many meritorious features that I have no hesitation in indorsing it as the system deserving preference over any other hitherto experimented upon, or likely to be devised in the near future."

by two reductions in speed, which has increased the pulling efficiency of the motor at least 50 per cent. In fact, the pulling power of the present motor is remarkable.

The elliptical grooved sheave that engages the traction rope is put about a cylindrical electric motor of the Storey type, the field of the motor acting as the axle for the sheave; thus, there is practically a differential block working a capstan, and the combination of those two powerful mechanical forces is applied directly to the towage of the boats.

A third great advantage obtained in shortening the motor was the lessening of its weight. The Tonawanda motor weighed 3,000 pounds; the new motor weighs 1,300 pounds. A great improvement has also been made in the upper and lower saddles that support the carrying and traction cables; they have been very much simplified.



LAMB ELECTRIC CABLEWAY FOR GERMAN CANAL HAULAGE.

(Drawn from Photographs.)

The order for the Erie Canal trial plant was given only a few weeks before its trial, and no time was available to change from the existing model which was designed especially for the purpose of hauling logs out of swamps. The conditions for this work differ considerably from canal boat towing. In log hauling the length of the motor is comparatively immaterial. At Tonawanda the low bridges under which the motor had to go, necessitated digging ditches in the side of the tow path, through which the bottom of the motor passed, as the motor was 9 feet in length from top to bottom. It was, therefore, important to lessen the height of the motor, as much as possible. How well this has been done is shown in the fact that the new motor, as built for a canal in Germany, is only 5 feet in length, while the Tonawanda motor was 9 feet.

In improving the motor in point of length a still more valuable improvement was made, namely, the worm gear was done away with and the gearing made by direct spur gear

It seems unfortunate that the State improvements in widening and deepening the Erie Canal should have prevented before this date the erection of the Lamb electric cableway by the Cataract General Electric Company, who have the franchise for that purpose. Especially is this so, as it now seems probable that a German canal will have the credit of being the first to substitute the electric cable motor for the mule. The accompany engraving was made from photographs of the German canal motor, the plant for which has been shipped recently by the Trenton Iron Company to that country.

There are hundreds of miles of American canals upon which millions of dollars have been spent for construction, which only wait on the Erie Canal to demonstrate the actual working of the electric cableway, when, as was the case in the introduction of electricity on street railways, new life will be given to the industry, and the country's bulky freights will once more be carried as in Europe by the cheapest of all methods, the canal.

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CAR TRACKS AND PAVEMENTS.

IT is said that the old Hewitt or center-bearing flat-rail, so generally employed on American street railways up to the advent of the electric car, was designed with the special object of keeping all other vehicular traffic off the car tracks. Whether this be true or not, the fact remains that that form of rail did not accomplish its alleged object, but on the contrary, its construction, while it did not keep other vehicles off the tracks, certainly induced them to stay when once there, on account of the difficulty of turning aside. There is still some of this old track left, but it is fast disappearing, owing to the general outcry against it from all sides, and to the fact that it is unsuitable for electric traction. But the substitution of a different type of rail in many cases has not met with the success hoped for, and the reasons are not difficult to discern. The question of street car tracks presents itself in two aspects, that is, from the side of the railway company and from that of the municipality, whose aim it is to have well paved streets. If a vote of the railways were taken it would perhaps be found that a majority would favor the old center-bearing rail, in girder form, not because it discourages poaching on the company's preserves, but because that type of rail does, as a matter of fact, possess advantages, due to its cleanliness, etc., that make it particularly well adapted for electrical work. But the edict against the rail has gone forth beyond the hope of revocation. Yet, we doubt whether the railway companies or the municipalities have, in the majority of cases been satisfied with the newer types of rails, even where the choice was free. This conclusion is inevitable after reading two papers read before the American Society of Civil Engineers by Messrs. Jas. Owen and Edward P. North, and the excellent discussion had thereon. As pointed out by the authors the question is frequently complicated by the relations existing between the railway company and the municipality. Thus, we may have three conditions, (1) where the municipality owns both track and street, (2) where the railroad company assumes the care of the entire pavement in the street, and (3) where the municipality cares for the pavement outside the tracks, and the company cares for the track and the pavement between the rails. The first two conditions are so rare that they scarcely require extended consideration, but the third case cited is one generally prevailing in the United States. Mr. Owen suggests that it would be of undoubted advantage to have the control of track and pavement vested in one authority, as more economic results can be obtained, and the riding and the driving publics would be placed on a fairly equal basis. But he is bound to admit that the general unsatisfactory administration of municipal affairs at the present time is a great barrier to municipal control, a sentiment in which we agree broadly with him. To place the entire pavement in the hands of the railroad company, however, does not commend itself to Mr. Owen, either, and for obvious reasons, as ideas as to the character of a good pavement might be likely to differ. Coming to the question of the type of pavement best adapted to streets containing street car tracks, it is probably true that the bad results obtained with nearly all kinds of pavements, even with the newer rails, is due to the extreme haste in the construction of the work, lack of appreciation of the future use and requirements of the road, and to lack of funds also. Indeed a prominent street railroad superintendent is credited with the remark that every street railroad track will, on an average, have to be renewed every ten years. This statement is probably not an overestimate, and considering the cost involved to the railway companies, it is evident that the track ought to receive as much consideration at the outset as does the power house. The influence of the rails on the street pavements per se is also a subject of pre-eminent importance, and in the paper of Mr. North, specially devoted to this aspect of the case, he shows the many conflicting conditions which have to be satisfied in order to attain permanency, with a satisfactory roadway for all kinds of traffic. After reading the various descriptions of rail sections and pavement constructions adopted, and the results obtained, one is led to the mournful reflection that this problem has not yet been fully solved by any means. Opinions differ even as to the ideal track arrangement. Thus to Mr. Owen, the ideal road with trolley tracks is probably the extension of Beacon street, Brookline, Mass. Here we note one wide roadway in the center, the trolley tracks sodded with grass, and a driveway on each side for local access. But, alas, it has been found that it is impossible to maintain the track at a good surface owing to the loam working down into the gravel bed beneath. Besides, the life of the ties is shortened, and in winter the freezing of the loam causes an upheaval of the surface so great in places that it has to be trimmed off in order to allow the cars to pass over without scraping, thus defeating the very object of having it a grass reservation. It would thus seem to be a good maxim for railroads to "Keep off the grass." There is also another aspect to track construction in its relation to the municipality, and that is the obstruction which it presents to street cleaning. Referring to this aspect of the case, Col. Waring, Street Cleaning Commissioner of New York, states that a recent calculation shows that if all the streets in New York City of suitable grade were asphalted, and if all the street tracks were like that laid on 106th street (a girder rail with a wide tread), allowing of easy sweeping, the $1,200,000 now paid out annually for street sweeping would be reduced to $700,000. Commenting on this fact, Mr. North goes a step further and shows that the sum of $500,000 which might thus be saved, at an interest of three and one-half per cent., represents a capital of over $1,400,000, a sum more than sufficient to put asphalt on all the streets of Manhattan Island, where the grade would not be too steep. These are figures worth contemplating by all municipalities, as well as by street railway companies. Of course the paramount question with the latter is to secure a clean, solid track, but we believe that much trouble could have been avoided in the past and much may still be avoided by a due consideration of the needs of all the classes of traffic for which the streets are provided. The papers and discussion in the transactions of the American Society of Civil Engineers are a most valued contribution on this subject, and their study will well repay every street railway manager.

THE MATHEMATICIAN AND THE PRACTICIAN.

IT would seem to be almost a work of supererogation to undertake at this late day a defense of those pursuing the science of mathematics of high or low degree; yet that is what Prof. Forsyth practically undertook to do in his presidential address before the Mathematical and Physical Section of the British Association at Toronto. Such a defense is not ill-

timed, considering the criticisms that are still made not only by the "practical" man whose knowledge of mathematics extends no further than the rule of three, or oftener of thumb, but also by engineers and even by physicists. To the criticism that pure mathematics usually leads to results of no immediate or even apparent practical application, Prof. Forsyth very properly replies that the same criticism may be laid at the door of many physicists, much of whose work is of the same character. Yet no one would limit the physicist to researches having only direct and immediate practical application as their final object. Such a course would put a blight upon science and defeat its highest objects. But Prof. Forsyth asserts that the charge of the unpracticalness of the pure mathematicians is not true, and that, on the contrary, in many cases they are guided in their investigations by the possibility of practical issues. He is undoubtedly justified in his contention that they cannot accept practical issues as the sole guide considering that practical issues widen from year to year and cannot be foreseen in the absence of a divining spirit. Whatever complaints may have come from practical workers as to the paucity of results of higher mathematical work, electricians and electrical engineers assuredly have no just cause for complaint. One could mention a dozen practical results of the highest importance traceable to mathematical investigation, and it need hardly be pointed out that modern alternating current work has been raised from the condition of empiricism to a scientific basis by the application of mathematical analysis to the results of experimental research. So far from the mathematician descending to the level of the practical man, Prof. Forsyth is rather of the opinion that the tide is turning and that the so-called practical man is gradually raising himself up toward the plane of the mathematician. He finds confirmation of his view in a glance at modern textbooks of engineering, and he goes so far even as to assert that a properly trained engineer should now possess a mathematical skill and knowledge in some directions, which not very long since could not freely be found among the professional mathematicians themselves. As stated at the outset, mathematicians need no apologists, but it is just as well to give the objectors an occasional sermon as Prof. Forsyth has done.

THE COST OF ARC LIGHTING.

WHILE the cost at which an arc light can be manufactured must always remain more or less a matter of the individual conditions of each plant, it is equally true that the price at which cities and towns can secure that light affords an excellent idea of the possible margin. The figures that find their way into print when some new municipal plant is proposed are often fantastic and grotesque to the last degree, and do infinite harm. A community which has been in the habit of paying $100 per year per light is staggered when confronted with a mass of "data," collected by a junketing committee, going to show that such lights can be made by a city plant for $50 a year, and the local company is at once bulldozed into doing its city business at a loss, or has the exquisite pleasure of seeing the city start a rival plant.

Figures recently compiled, not from two or three plants, but from nearly 1,100 plants, with 300,000 lights, scattered over forty-six States, and including stations of all sizes under all conditions, ought to be trustworthy. These figures show that the general average contract price for lights burning 3,326 hours a year, with coal costing $3.03 per ton, is $101.18. The cost per lamp hour is .034, and the candle-power per hour for 1 cent is 580. In Pennsylvania, with coal at $1.56 per ton, the prices average $85.75, and in Ohio, with coal at the same price, the prices average $78.87. But in Pennsylvania the average burning is 3,931 hours per year, whereas in Ohio it is only 3,350. In California, with coal up to $7 per ton, the average price per light is $119.68; while in Colorado, with coal at only $3.18, the lamp price reaches $129.31, but the Coloradan gets 100 c. p. more for 1 cent than does his Californian brother, owing to the fact that his lamps burn more than 500 hours longer each year. It is peculiarities and idiosyncracies like these, due to local conditions of cost of labor and fuel, cost of land and buildings, size of the community, number of lights, and other things, that render so absurd and unfair the tables offered to a credulous public by such municipal lighting experts as Prof. Parsons, Prof. Bemis, Mr. E. M. Grout and others.

THE FAILURE OF THE PHILADELPHIA MUNICIPAL GAS PLANT.

IT will be remembered that a short while ago we published some figures from the report of a special committee of investigation showing the frightful loss incurred in the operation of the municipal gas works of Philadelphia. The lost to the city was estimated at $700,000 a year, and the cost of labor was three times the average of that in private plants, on the basis of relative output. Evidently something had to be done, and Mayor Warwick now proposes to the City Council that the plant be leased; so that its immediate and necessary repair, improvement and enlargement may be provided for. He says: "This work will require the expenditure, within three years of at least $5,000,000, which the city cannot obtain except by increasing the tax rate. The subsequent enlargement of the plant to keep pace with the city's growth will require at least $10,000,000 more during the term of the lease, for which also the city has no resource except taxation. I have most carefully considered the matter, which is one of great importance to the city, and I submit it to you, deeming it worthy of your most earnest consideration."

The United Gas Improvement Company offers to take over this miserably mismanaged plant on a lease, it is understood, spending $10,000,000 to bring it up to date, paying the city $1,000,000 in cash, and turning in a rental that in thirty years will amount to not less than $36,725,000. It is impossible not to believe that the offer will be accepted, and it is a mounrful commentary upon the municipal plant craze that at a time when private gas works in other large cities are all exhibiting an appreciated value, this Philadelphia plant is a wreck, and will owe its rescue to private enterprise and good management. Yet, we do not regard the Philadelphia instance as exceptional. There may be and probably are several municipal plants well run, but it is as sure as the rising of the sun that the great majority of them are carried on at an actual loss.

GLICKMAN'S WHISKERS.

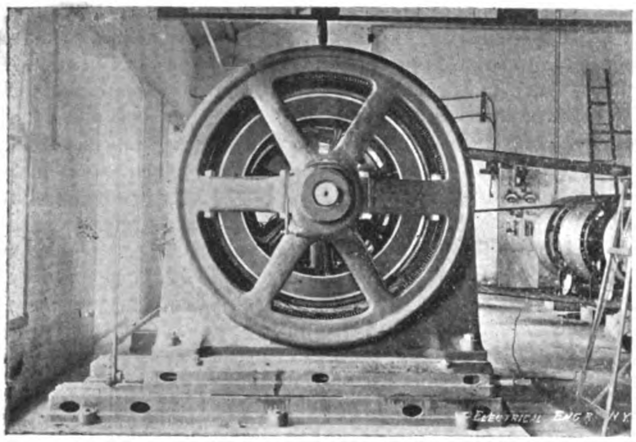
MR. ISAAC GLICKMAN, of Bayonne, N. J., carrying three mackerel and some highly ornamental whiskers on one of the trolley cars of the Consolidated Traction Company was set upon by five toughs, who slapped his face with the fish and when they retired from the scene of conflict carried with them large handfuls of hair as mementoes of the incident. Although the conductor and motorman came to his rescue, Glickman sued the company for the loss of his whiskers, and the court has now held that the company was not responsible. The value of the whiskers was put as low as $200, which is moderate enough, but we must confess that our sympathies and opinions are with the corporation. If anybody was to blame, it was the police force of the vicinity. Obviously, it would not do to charge damages upon the owner of a hack or of a hired bicycle, because the person riding happened to excite the pugilistic or thievish nature of some blackguard or other, and the trolleys have trouble enough of their own without being responsible for the derelictions of the police.

MODERN TELEPHONY.

ONE of the earliest fields for the development of practical telephony was southern New England, and it may truly be said that the priority thus established has been well maintained by the energy and progressiveness of the company which has been working in that field. We illustrate and describe in this issue one of its latest exchanges just finished, that at Hartford, Conn., and it will be noted that the study to give good service at moderate rates and to open up new channels of usefulness for the telephone has gone far toward developing a system that might be regarded as a perfect demonstration of practical modern telephony in America. The Hartford exchange is neither very large nor very small, but hits the average in size and affords an excellent criterion. The map accompanying this article gives a striking idea of the manner in which a Hartford subscriber can easily reach every corner of the State of Connecticut over the multitudinous circuits of the ubiquitous Southern N. E. Company.

NIAGARA POWER DISTRIBUTION BY TESLA MOTOR.

Manager Frank G. Lott, of the Buffalo and Niagara Falls Electric Light and Power Company, is remodelling his station at Niagara Falls, and among other improvements has had the Westinghouse Electric and Manufacturing Company install a 400 horse-power motor of the Tesla induction type.



TESLA 2-PHASE MOTOR, GORGE RAILWAY, NIAGARA FALLS.

This motor is the largest of the kind ever made, and it is to have a companion of the same size and class. The new motor takes the current direct from the generators in the power house of the Niagara Falls Power Company at 2,000 volts. The two 300 horse-power motors formerly in use in this station have been thrown out and these later and larger motors installed. The economy of the new motor will be generally recognized, and the picture well portrays the size of the machine.

COST OF STEAM POWER.[1]

BY H. A. FOSTER.

THIS paper is submitted to the Institute with the hope that it may be of some assistance to other members who may be called upon for opinions as to cost of power, and as a record of a rather persistent attempt to learn something about the subject a little more diverse in conditions than the writer has been able to find in a somewhat extended search.

[1]Read before the American Institute Electrical Engineers. Abstract.

The author states that all the results are based on indicated, and not on net power, as is most usual, and the reasons are given. He gives a list of various types of plants on which test was made, and attention is called to the fact that while it is acknowledged that not enough were tested of any kind to enable one to compute a fair average, yet the argument the writer wishes most strongly to emphasize is, that, even in the kinds of business running most nearly alike, and having large plants of almost identical design, the cost of power varies so much that it is unsafe to state an average cost for any, but, given all the conditions, it may be possible to state approximately what the cost will be for the particular plant under consideration.

In Table I. the rated horse-power of engines is in most cases the maker's rating. In Table II. it will be noticed that ten plants have no charge for water, it being obtained from adjacent streams. One item that amounts to a considerable expense in cities is the removal of ashes; in some cities the authorities remove ashes and use them for filling, the mills being at no expense except to wheel them outside the boiler room. Table III. gives the types of engine employed in the various plants tested. The author has added additional tables showing costs for the year, day and hour per horse-power and the rated capacity of plant, the percentage used, and compares the operating and fixed expenses per hour and by percentage each is of the total.

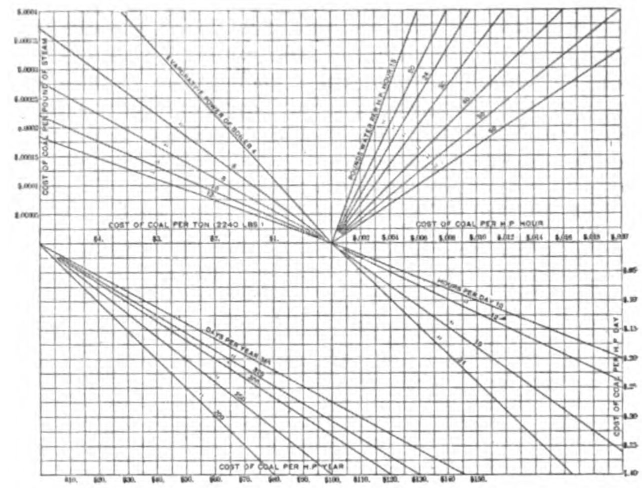


CHART FOR DETERMINING COST OF COAL PER HORSE-POWER PER ANNUM.

From this diagram the cost of coal per H. P. per annum is calculated as follows:
Beginning at "Cost of Coal per Ton" at left of centre of sheet, ascend vertical line to diagonal marked "Evaporative Power of Boilers," then follow horizontal line to the right to diagonal marked "Pounds Water per H. P. Hour," then follow vertical line downward to diagonal marked "Hours per Day" and from this point follow horizontal line to the left to point of intersection with diagonal marked "Days per Year." From this point of intersection follow vertical line downward to a scale at bottom of the diagram giving "Cost of Coal per H. P. Year."

Attention is called to the fact that in one case a portion of the charge for replacing a whole bank of boilers is included, the original installation having lasted about three years. Several of these "extraordinary" items were found, and must necessarily be included under power costs.

Attention is also called to another of those items often overlooked in estimates of this kind, namely, the use of different

	OUTPUT.						OPERATING EXPENSES.						FIXED CHARGES.					
No of plant.	Average H. P. develpd.	Per cent. of total engine capacity.	No. of days	Time per day. hrs.	Time per day. mins.	Hours per annum.	Fuel.	Wages	Supplies.	Repairs	Water.	Total.	Interest.	Depreciation.	Insurance.	Taxes.	Total.	Cost per horse-power
1	296.7	78	297	24	..	7,128	$26.20	$10.95	$1.68	$5.77	$0.96	$45.56	$2.55	$3.52	$1.07	$0.67	$7.81	$53.37
2	210.9	85	290	24	..	6,960	22.00	13.26	3.94	1.13	....	40.33	2.61	2.80	1.50	.95	7.86	48.19
3	58.8	47	365	24	..	8,135	36.30	44.60	1.90	3.60	2.90	97.30	13.87	12.24	2.61	5.10	33.82	131.12
4	12.4	31	361	9	..	3,067	48.93	84.12	9.13	1.62	4.13	147.93	9.46	11.62	1.89	2.43	25.40	173.33
5	21.5	33	361	9	..	3,711	28.82	51.09	7.34	1.24	1.98	90.47	8.13	6.98	1.94	.75	17.80	108.27
6	70.4	32	365	23	..	7,461	34.00	55.07	5.09	5.40	2.13	101.69	5.77	9.24	4.62	1.13	20.78	122.45
7	1,345.5	54	365	11	..	4,008	11.75	8.90	.55	2.01	.07	23.28	3.71	5.21	.26	.24	9.42	32.70
8	129.3	78	365	12	27	4,544	18.25	9.82	.58	.72	.77	30.14	2.97	5.28	1.16	....	9.41	39.55
9	1,352.	62	365	24	..	8,760	13.76	13.00	2.74	3.53	....	33.03	13.10	12.78	3.53	....	29.41	62.44
10	36.7	33	365	24	..	8,327	36.71	81.62	8.70	10.22	....	137.25	44.10	43.40	1.30	7.80	96.70	233.95
11	42.4	39	365	24	..	8,755	26.54	54.49	3.96	1.39		86.38	26.41	28.29	1.43	7.07	63.20	149.58
12	173.	58	313	3	..	939	11.98	8.53	1.05	.88	.22	22.66	3.40	3.22	1.46	.55	8.63	31.29
13	53.	32	309	15	30	4,790	24.43	25.50	2.35	1.93	2.73	56.94	7.29	9.57	1.19	1.46	19.51	76.45
14	20.9	32	365	24	..	8,110	49.30	55.30	8.83	3.59	6.10	123.12	10.79	13.33	2.15	2.15	28.42	151.54
15	32.9	41	330	10	20	3,410	9.58	8.74	2.92	1.22	.10	22.56	1.88	3.76	.19	....	5.83	28.39
16	166.7	84	313	9	50	3,073	5.46	7.48	1.36	.58	.31	15.19	1.57	2.02	.74	.14	4.47	19.66
17	1,174.8	98	306	9	40	2,958	7.62	1.82	.54	.21	....	10.19	2.30	2.35	.35	60	5.50	15.69
18	926	93	307	9	40	2,963	8.64	2.20	.62	.27	....	11.73	3.68	3.93	.20	.96	8.77	20.50
19	2,422.	97	306	9	40	2,958	11.12	3.18	.81	.56	...	15.67	2.88	2.85	.25	.75	6.73	22.40
20	1,909.7	95	306	9	40	2,958	8.76	2.26	.82	1.56	....	13.40	2.62	3.21	.22	.58	6.63	20.03
21	1,278.7	01	293	9	40	2,831	7.40	2.41	.46	.22	....	10.49	2.57	2.96	.16	.54	6.23	16.72
22	1,010.86	84	306	9	40	2,958	8.89	2.24	1.35	3.22	....	15.70	3.04	3.36	.24	1.10	7.74	23.44

TABLE I.—ANNUAL OUTPUT AND COST PER HORSE POWER.

priced coals in the same locality. Plant No. 17 is of the best and most modern type both as to engine and boilers, and yet by using coal at $3.35 per ton instead of low-priced mixtures at a dollar or more less in price, the cost per horse-power is of $3 per net ton, which is the unit used in the locality where most of the tests were made, and tables exhibit the results.

The latter part of the paper is devoted to comparison with the work of others in the same line, and although the results

No. of plant.	ENGINES. No. of Engines.	Type.	How Run	Cylinders. Diam high inches	Diam low inches	stroke inches	Rv'ls per min.	Rated H. P	VALUES. Total power plant.	Per rated H. P	LABOR. Engineers. No.	Rate per mo.	Firemen, etc No.	Rate per mo.	Purposes for which steam is used other than for power, from same boilers, at same time.
1	1	Corliss	non-condensing	22	..	48	80	380	$14,865	$39.12	2	$78	2	$60	Exhaust heating, during winter.
2	1	Cummer	condensing	22.1	..	42	78	250	11,000	44 00	2	78	2	45	
3	1	Corliss	non-condensing	16	..	36	86	125	18,300	89 27	1	125	2	48	Steam tables, elevat: r and other pumps.
	1	Slide Valve	used occasionally.	12	..	20	162	80			2	62	.	..	
4	1	Slide Valve	non-condensing	12	..	16	125	40	2,337	58.42	1	65	.	..	Steam tables ; exhaust for building in winter.
	1	Compound Automatic	non condensing	8	14	14	194	65							
5	1	Vertical	non-condensing	16 7/16	..	20	74	65	1,500	23.08	1	90	.	..	Steam tables and neighboring building.
6	1	Vertical Compound	condensing	15	30	20	60	100	10,143	46.10	1	125	1	52	Steam tables ; heating building in winter.
	1	Straight Line	non-condensing	10	..	16	235	60			2	65	1	40	Elevator and other pumps.
	1	Ball	non-condensing	10	..	12	275	60							
7	1	Corliss Compound	condensing	30 3/8	56	60	68	1,500	100,000	40.00	1	100	4	55	
	1	Corliss Compound	condensing	26	42	48	75	1,000			2	75	4	50	
											2	50			
8	1	Wheelock	non-condensing	17	..	38	100	165	11,200	67 88	1	45	1	36	
9	2	Holly double Compound	condensing	36	72	48	16	....	632,000	287.90	1	167	9	61	
	1	Holly double Compound	condensing	33	66	48	16	...			3	87	2	40	
	2	Worthington Compound	condensing	38	66	50	10	....			7	40	6	40	
	1	Worthington Compound	condensing.	29	50	50	10	....			7	45			
10	2	Holly Compound	condensing.	12	24	22	21	....	40,478	367 98	1	100	2	45	
											1	75			
11	2	Holly Compound	condensing	12	24¼	22	19	...	28,000	254.54	1	100	2	48	Part of last year for electric power station in same building.
											1	50			
12	1	Slide Valve	non-condensing	28	..	36	78	300	9,500	31.66	1	78	1	45	For small electric light plant occasionally.
13	2	Compound Automatic	non-condensing	8	13¾	12	235	65	7,730	46.85	1	100	1	43	For elevator and other pumps and to help exhaust in winter.
	1	Westinghouse	non-condensing	..	..	..	..	35			2	65			
14	1	Buckeye	non-condensing	12	..	22	140	65	4,500	69.23	1	75	1	48	For heating ovens and part of building.
											1	56			
15	1	Slide Valve	non-condensing	12	..	12	280	80	3,000	37.50	1	48	.	..	To help exhaust in winter. Exhaust used for dry rooms all the year.
16	1	Wright	non-condensing	22¼	..	42	68	200	7,000	35.00	1	78	1	45	To help exhaust in winter. Exhaust used for dry rooms all the year.
17	1	Corliss trip. comp.	condensing	24	1-34 / 2-36	60	62½	1,200	57,500	47.92	½	100	2	35	1st asst. Eng. @ $32 and 1 coal wheeler @ $30
18	1	Corliss dbl. tand. comp.	condensing	22	40	60	68	1,000	71,434	71.43	1	75	2	35	One oiler @ $35 for slashers and vapor.
19	1	Corliss double	½ condensing	22	..	60	54	600			1	75	2	39	Exhaust from one cyl. of Nos. 1 & 2 for slashe
	1	Corliss double	½ condensing	22	..	60	64	600			1	100	2	32	Live steam for heating and vapor.
	1	Corliss cross comp	condensing	24	44	60	68	800			1	50	1	42	
	1	Corliss cross comp	condensing	22	40	60	65.8	500	146,550	58.75	2	42	3	36	Watchman @ $48.
20	1	Corliss cross comp	condensing	28	52	60	66¼	1,200			1	90	3	36	One coal wheeler at $30.
	1	Corliss double	¾ condensing	28	..	60	57	800	110,000	55 00	2	36	2	26	Exhaust form slashers and vapor.
21	1	Corliss cross comp	condensing.	28	52	72	61	1,400	68,789	49.14	1	100	2	38	Two wheelers @ $33.
22	1	Corliss cross comp	condensing.	28	52	72	57	1,200	64,000	55.33	1	67	1	40	One fireman @ $34, one wheeler @ $47, stea for vapor and slashers.

TABLE II.—POWER PLANT EQUIPMENT, ENGINES, VALUE AND LABOR.

very little reduced below that for older and much less economical installations. The mill architect, consulting engineer and experts without number may lay down the law, and show conclusively what is the proper fuel to use under the existing circumstances, and the operating engineer will still continue to use the kind he likes best, or, in many cases, the kind the mill agent can get for the lowest price per ton.

No. of Plant.	FUEL. Kind Used.	Average cost per 2,000 lbs.
1	Soft Slack	$2.01
2	Soft run of mine and slack	1 82
3	Pea and Nut Anthracite	2.25
4	Natural Gas	Per month
5	Soft Nut and hard Screenings	1.94
6	Soft Coal. Yough	2.00
7	Hard and Soft Slack	1 45
8	Soft and hard Slack and Screenings.	1.77
9	Soft Coal. Estimated	2.00
10	Soft Coal	1.95
11	Soft Nut and Slack	
12	Soft, Nut and Lump Coal	2.32
13	Soft Nut Coal	2.00
14	Soft Coal and Slack	2.05
15	Soft run of Mine Coal	1.90
16	Shavings and a litt'e Soft Coal	
17	Soft Coal	3.35
18	Half each, Hard Pea and Soft Coal.	2.55
19	¾ Soft, ¼ Rice	2.68
20	150 H. P. each. Buckwheat	2.40
	150 H. P. each. Buckwheat	2.40
21	½ Soft, ½ Pea and Rice hard	2 57
22	Cumberland Coal	3.10

TABLE III.

It is, of course, quite obvious that very poor comparison can be made where prices vary so much, and therefore the writer has reduced the greater variable, i. e., the cost of coal, to a common price and retabulated the whole at the average rate

COMPARISON OF COST OF POWER PER ANNUM.
BY VARIOUS TYPES OF ENGINES. COAL AT $3.00 PER 2,000 LBS.

Type of Engine and Number of Plant.	Power Developed.	COST PER H. P. PER ANNUM. Operating Expense.	Fixed Charge.	3,080 Hours.	8,750 Hours.
Slow Speed Non-Condensing 1	297	$71.92	$7.81	....	$79.73
" " " 3	59	117.55	33.82	....	151.37
" " " 5	22	88.24	17.80	106.04	....
" " " 8	129	21.31	9.41	30.72	....
" " " 16	187	18.20	4.47	22.67	....
" " " 12	173	85.90	8.63	94.53	....
" " " Emery B	556	23.66	8.95	32.61	....
" " " " B	556	64.91	8.96	....	73.87
" " " Main XXVIII.	1,000	19.37	6.49	25.86	....
High Speed Non-Condensing 14	21	157.86	28.42	....	186.28
" " " 4	12	175.13	25.40	200.53	....
" " " 15	33	25.38	5.83	31.21	....
" " " 13	53	44.54	19.51	64.05	....
" " " Emery Eng. Mag.	10	73.15	6.00	79.16	....
" " " " " "	75	36.50	6.50	43.01	....
" " " " " "	542	26.84	8.62	35.46	....
" " " " " "	542	74.02	8.82	....	82.64
Combination, Slow Comp. Cond. High Speed Non-Cond. 6	70	137.79	20.76	....	158.55
Combination, Slow Speed Comp. Cond. and Dbl. Cond. 19	2,422	14.17	6.73	20.90	....
20	1,910	16.33	6.63	22.96	....
Compound High Speed Non-Cond. Emery C	542	22.11	8 01	30.12	....
" " " " " C	542	60.88	8.02	....	68.90
Compound High Speed Condensing. Emery G	542	18.03	7.57	25.60	....
" " " " " G	542	49.76	7.56	....	57.32
Triple Comp. High Speed Non-Cond. Emery. D	542	20.73	8 81	29.57	....
" " " " " " D	542	57.12	8.80	....	65.92
Triple Comp. High Speed Condensing. " I	542	15 93	8.02	24.00	....
" " " " " " I	542	43.98	8.02	....	52.00
Slow Speed Condensing 2	211	68.87	7.83	....	76.75
" " " Emery F	556	17.53	7.81	25.34	....
" " " " F	556	48.27	7.81	....	56.08
" " " " Main XXVIII.	1,000	16.82	6.36	23.18	...
High Speed Condensing. Emery E	542	19.33	7.36	26.75	....
" " " " E	542	53.44	7.36	....	60.80
" " " " Eng. Mag.	150	26.65	6.00	32.65	....
Slow Speed Compound Condensing 7	1,346	27.75	9.42	37.17	....
" " " " 18	926	13.77	8.77	22.54	....
" " " " 21	1,279	12.75	6.23	18.98	....
" " " " 22	1,011	16.08	7.74	23.82	....
" " " " Emery H	556	16.18	7 93	24.11	....
" " " " " H	556	44.50	7.94	....	52.44
" " " " Emery Eng. Mag.	250	19.96	6.40	20 36	....
" " " " Webber XXIII.	1,050	13.31	6.62	19 93	....
" " " " " XXIV.	650	15.68	6.78	22.46	....
" " " " Hale XXV.	....	10.75	6 21	16.96	....
" " " " Main XXVIII.	1,000	13.40	6.36	19.76	....
Slow Speed Triple Comp. Condensing 17	1,175	9.73	5.50	15.29	....
" " " " " Emery J	556	14.82	8.93	23.75	....
" " " " " " J	556	40.52	8.95	....	49.77
" " " " " " L	556	13.14	9.43	22.57	....
" " " " " " L	556	36.27	9 42	....	45 69
" " " " " " Eng. Mag.	500	15.19	7.20	22.39	....
Water Works Pumps. Compound Cond. 9	1,352	39.86	29.41	....	69.27
" " " " " 10	37	165.30	96.70	....	261.00
" " " " " 11	42	100.65	63 20	....	163 85
" " " Triple " " XXVI	560	47 30	11.64	....	58.94

TABLE IV.

seem to agree quite as closely as could have been expected, yet the writer wishes to still further emphasize the fact that the extremes in all cases are too far apart to make it correct to state average cost in general. (See Table IV.)

Through the kindness of Mr. L. B. Stillwell, electrical director of the Cataract Construction Company, the author has included in this paper a very useful diagram developed by him for deducing the cost of coal per horse-power for any given case. This diagram is shown on page 233.

A SUMMARY OF ROENTGEN RAY THEORIES.—I.

BY A. VOSMAER AND F. L. ORTT.

(Electrical Research Laboratory, The Hague, Holland.)

THE most important question whether Röntgen rays are to be considered as falling into the domain of light, or whether they are something else, has occupied so many minds, that the literature on this subject has grown enormously; but is it settled yet whether they are transversal waves of very small wave-length, or longitudinal waves, or vortex motion of the ether, or longitudinal impulses, or due to electromagnetic dispersion, or radiant matter? Having read so many theories, with so many supporters and opposers, one gets puzzled what to believe. Not a small part of the confusion is caused by the number of contradictory experiments; and no wonder at this, the question being, in fact, of the utmost complication—that is to say, not only as to the nature of the rays themselves, but also the way in which to get them. Being engaged in the study of silent electric discharges, it was rather in our line to consider the question of cathodic, as well as of our anodic, discharges. Thus we arrived at a conclusion about the nature of Röntgen rays, which explains a great deal, though we must confess that certain assumptions have to be made. This is not an attempt to explain this most difficult problem, but to suggest an hypothesis that is most nearly in accordance with experiments, so far as they go.

We consider Röntgen rays to be nothing but discharged cathode rays, and will now test this hypothesis by seeing how it will explain some of the most striking experiments and facts. As a matter of fact, cathode rays are deflected by a magnet; they obey the law of attraction of a current by a magnet; i. e., they behave as a current or stream of negatively charged particles. These negative particles impinge upon the glass wall of the tube, which, as is well known, possesses a strong positive (external) charge. Is there anything strange in the idea that those particles may lose their charge when in contact with the positive charged wall, and proceed on their way as discharged particles? These discharged particles cannot be, and are not, attracted by a magnet; why should they be? Hence the essential difference between cathode and Röntgen rays is explained. Röntgen rays would thus discharge a negatively or positively charged body, as a matter of course, since any electrified body, struck by neutral particles, always loses its charge.

Now let us consider some important details; in the first place, with regard to the focus tube. Some people do not accept the property of being reflected as possessed by the Röntgen rays. It seems to us that the experiments of Tesla with his T-tube, allowing him to take simultaneously a sciagraph from reflected and from rays that have passed through different plates of metal, are conclusive in this respect; but they prove that the total amount of reflection varies not very much for the least and for the best reflectors; the maximum result obtained with zinc (platinum does not seem to have been tested) was only 3 per cent. Probably platinum will give a higher percentage of reflected rays; but even then it does not sufficiently account for the large difference of efficiency of the ordinary and the focus tube. According to our theory the real cause of the high efficiency of the focus tube lies in the fact that the cathode rays strike on an actual anode, instead of upon an anode by induction.

This, so far, is not new. To quote Lodge, in an article written some time ago: "Hence, undoubtedly the X-rays do not start from cathode, or from anything attached to it, but do start from a surface upon which the cathode rays strike, whether it be an actual anode or only an anti-cathodic surface; best, however, if it be an actual anode."

Röntgen and Rowland had discovered the same thing. According to our theory, it is evident that the negatively charged particles can lose their charge sooner and more completely when they strike an actual anode, than when they strike an anode by induction (of greater surface, and thus of smaller density). Everybody will agree with Prof. Peckham, where he says that the discharge-tube is a resonator for its coil, and when the coil and tube are properly attuned the maximum effect is obtained. We should say, when the discharging capacity of the surface struck by the cathode rays can keep time with the vibrations of the intermittent current or stream of charged particles, the most intense Röntgen rays will be obtained. If discharging—or, better to say, neutralizing—of the waves of negative particles from the cathode be not synchronous with their impinging upon the focus or wall, they cannot lose all their charge, and will proceed either as particles with a minute negative charge, or with a minute positive charge, or perhaps mixed with neutral parts. The result will be feebler Röntgen rays, and, according to the preponderance of the one or the other particles, these rays will discharge an electrified body and give it charge according to its own charge. Borgmann found that a negatively charged plate, when exposed to Röntgen rays, lost its charge to become positively charged; when the plate was positively charged, it lost part of its charge. Righi found just the contrary; a positively charged plate lost its charge to end with a negative charge. Porter, and nearly all other experimenters, found in all cases a complete loss.

We could explain these differences by admitting that neither Borgmann nor Righi had pure Röntgen rays, but had them mixed with positive and negative rays, respectively. We consider Porter's $X_1X_2X_3$ rays and Lenard's gamut of rays of more and less magnetic deflectibility, as Röntgen rays of less and more purity, i. e., neutrality. The more perfectly the negative charge has been taken away by the anode—without, however, imparting a positive charge instead—the more intense the Röntgen rays will be, and the stronger penetrating power they will possess. It is hardly necessary to say that it must be very difficult to obtain perfectly neutral rays; this end will obviously only be attained when the whole system of generating—current, frequency, self-induction, capacity, vacuum, size and form of tube, and all the rest—be in true harmony with one another; and to realize this, means no small thing to do in practice.

We do not venture to say that our theory explains everything, but we do think it explains much; we do not ignore the fact that it is difficult to understand how the Crookes' radiant matter could pass through the glass wall as discharged matter, but the theory of ether motion also presents difficulties. Experiments on the Lenard rays passing as charged particles through aluminum, are described in "Nature," of May 27 (p. 93). Why should the etheric disturbance in the air answer so closely to the vacuum in the tube? Why should the rays, if they be ether vibrations, which in any case must be of so short a wave-length that the well known properties of light do not show, make any difference whether they are obliged to pass through one or the other metal or material? If the intermolecular space be of any influence on them, one should expect refraction in those materials that show greater resistance to the rays passing.

The strongest proof for our theory is Lafay's experiment, where he found that Röntgen rays, passed through a negatively charged leaf of silver, can again be deflected by a magnet, and in the same direction as the cathode rays in the tube; and when the leaf was positively charged, in the opposite direction. That means that neutral, non-deflectible rays, after recharging, become again sensitive to the magnet; the deflection being absolutely in accordance with electromagnetic laws of attraction and repulsion. Unfortunately this experiment, repeated by Lodge, has not been confirmed by him; but it is easy to understand that recharging, just like discharging, is no simple thing to accomplish.

(Our next issue will contain a review of the theory of Messrs. Vosmaer and Ortt.—Eds. E. E.)

VARIETIES OF CATHODE RAYS.

Prof. Silvanus P. Thompson described last week to Section "A" of the British Association his researches on the varieties of cathode rays which have been discovered inside a vacuum tube excited by electrical discharge. He classifies these rays as follows:

(1) Orthocathodic rays, which are the orthodox rays that are deflectable by a magnet, that are fluorescifiant and which excite Röntgen rays.

(2) Paracathodic rays, which are also deflectable and fluorescifiant, but which do not excite Röntgen rays.

[1]From London Nature.

(3) Diacathodic rays, which although fluorescifiant are non-deflectable by a magnet and do not excite Röntgen rays; and

(4) Isocathodic rays which differ from the diacathodic rays in being deflectable by a magnet. The third class of rays is produced beyond an electrified metallic screen or gauze plate placed in the path of ordinary cathode rays. They produce a species of fluorescence of a yellowish or greenish color upon the inner surface of the tube, and will cast shadows of intervening objects.

MISCELLANEOUS

A NEW METHOD OF MEASURING HYSTERESIS IN IRON.[1]

BY J. L. W. GILL, B. A. Sc., of McGILL UNIVERSITY, MONTREAL.

WHEN a specimen of iron is passed to and fro through a magnetic field without any motion of rotation, the direction of the field being reversed each time the specimen passes out of the field, the iron passes through a complete magnetic cycle for each cycle of motion, and a definite amount of energy is lost, due to hysteresis in the iron. Since energy is supplied only in the form of mechanical work upon the specimen, the hysteresis loss is, by the law of the conservation of energy, numerically equal to the resultant mechanical work expended.

The instrument described below is based upon the above principle, and its function is to measure the work so expended.

The magnetic field is obtained by the use of a solenoid wound on a brass tube. The specimen to be tested is placed in a stirrup, which is sufficiently small to pass through the solenoid, and is suspended by a helical spring, the point of suspension being vertically above the center of the solenoid. Another helical spring extends from the bottom of the stirrup to a point vertically below. This serves to keep the stirrup steady. The stirrup is suspended so that when the solenoid is in its lowest position the specimen is out of the magnetic field, being above the solenoid. As the solenoid is moved up the stirrup and specimen pass through it, and when the solenoid is in its highest position the specimen is practically out of the field. If the solenoid be moved once up and down, the field being reversed when the specimen is out of it, the specimen passes through a complete magnetic cycle, provided the specimen has been once through the field and is initially in that particular cyclic state.

The resultant work done on the specimen may be determined by observing the attracting force when the solenoid is in different positions, and then drawing a distance-force curve. The integral of this curve gives the resultant work done on the specimen. The force at different points can be determined by calibrating the springs which support the stirrup, and then observing the extension of these springs. The author has determined the hysteresis loss in different specimens at different inductions by this method, the extension of the springs being observed with the aid of a microscope.

To make this method practical, a simple integrating apparatus is attached to the instrument above described, by which the work done is integrated automatically. The constant of the instrument is determined by placing a known weight in the stirrup, and observing the amount of rotation communicated to the disc when the solenoid is moved through a known distance. The specimen may be taken through a number of cycles and the readings allowed to accumulate. The average of a number of cycles is thus obtained.

ON THE RELATIONS BETWEEN ARC CURVES AND CRATER RATIOS WITH CORED POSITIVE CARBONS.[1]

BY HERTHA AYRTON.

WHEN an arc is burning between a solid negative carbon and a positive of given diameter, the P.D. between the carbons varies according as the positive carbon is cored or solid.

When the Length of the Arc is Kept Constant.—1. The P.D. is in all cases higher with the solid than with the cored carbon.

2. With a solid carbon the P.D. continually diminishes as the current increases; with a cored carbon the P.D. either diminishes much less than with a solid carbon, or remains constant for all currents above a given value, or actually increases with the current after falling to a minimum.

With a Constant Current.—1. The P.D. is always higher with solid carbons than with a cored positive carbon, but the difference between the two diminishes as the arc increases in length. 2. The rate of change of P.D. with change of length is constant with solid carbons, but diminishes as the length of the arc increases with a cored positive carbon. 3. This rate of change becomes smaller and more nearly constant for all lengths of arc as the value of the constant current increases. 4. The P.D. corresponding with length of arc 0 diminishes as the current increases with solid carbons, but increases with the current with a cored positive carbon.

These differences can all be accounted for on the hypothesis that with a given solid negative carbon and a positive of a given diameter the P.D. required to send a given current through a fixed length of arc depends principally, if not entirely, on the nature of the surface of the crater being greater or less according as the carbon of which this surface is composed is harder or softer.

By the term area of the crater is meant the area of the mouth of the crater, or, still more accurately, the plane area of that region of the end of the positive carbon which is sharply cut off from the rest by its peculiar brilliance and whiteness. The area of the soft carbon in the surface of the crater is taken to be the projection on the mouth of the crater of that area of the crater that is composed of soft carbon, and the proportion of soft carbon in the surface of the crater is measured by the ratio of the area of the soft carbon to the total area of the crater. This ratio for each current and length of arc will be called its "soft crater ratio."

The ratio of the area of the hard carbon in the surface of the crater to the area of the crater will be called the "hard crater ratio."

Arcs of Constant Length.—The area of the crater is known to increase as the current increases. With a constant length of arc, therefore, when the current is very small the whole of the crater will be in the core, as the current increases some hard carbon will be embraced by the crater, and the P.D. will therefore, by the hypothesis, be higher than if the whole crater were of soft carbon. The larger the current the greater will be the area of the crater, and consequently the greater will be the amount of hard carbon in its surface; hence, by the hypothesis, the difference between the actual P.D. and what the P.D. would be if the whole carbon were as soft as the core must increase as the current increases, until in some cases the P.D. with the cored carbon, after reaching a minimum, would actually rise as the current increased, as it is found experimentally to do.

Constant Currents.—It has not hitherto been known how the area of the crater varied with the length of the arc. From the hypothesis and the curves connecting P.D. and length of arc for constant currents it was deduced that—

1. When a cored positive carbon is used and a constant current is flowing the area of the crater must increase as the length of the arc increases.

2. The change that takes place in the ratio of the soft carbon to the total amount of carbon in the surface of the crater with a given change of length must diminish as the arc increases in length.

3. The change that takes place in the ratio of the soft carbon to the total amount of carbon in the surface of the crater with a given change of length must be smaller, and the rate of change must become more nearly constant for all lengths of arc as the value of the constant current increases.

Remembering that the ratio of the area of soft carbon to the area of the crater is called the "soft crater ratio," these three conditions may be put thus—

1. With a cored positive carbon, and with a constant current flowing, the area of the crater must increase, and consequently the soft crater ratio must diminish as the length of the arc increases.

2. The change of soft crater ratio with change of length must diminish as the length of the arc increases.

3. The change of soft crater ratio with change of length must be the smaller, and the rate of change must become the more nearly constant the larger the current. The results of tests proved the truth of the hypothesis.

[1]Abstract of a paper read before the British Association at Toronto.

THE "CANADIAN MANUFACTURER," of Toronto, has done a public service by bringing out in its August 6 issue the 1897 Canadian Tariff, the 1897 United States Tariff, the British Tariff, the British Merchandise Marks act and the Newfoundland Tariff. It is a very valuable issue.

HOUSTON, TEX., is considering and discussing a plan to spend $100,000, raised by bonds, for a city electric light plant.

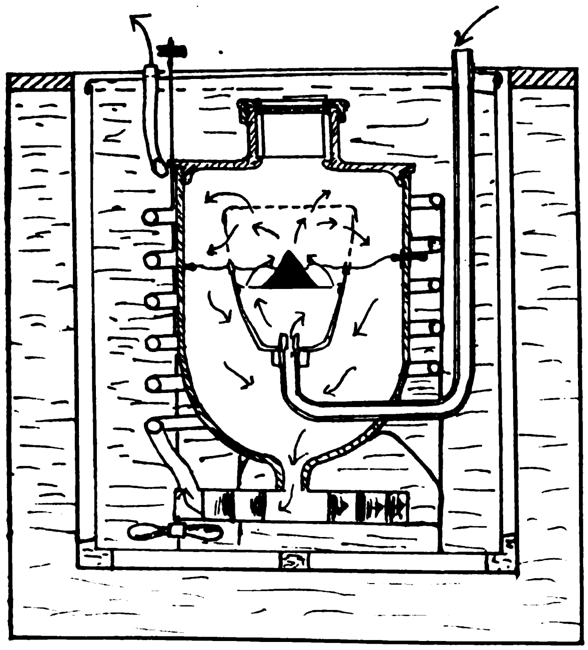
A NEW FORM OF COAL CALORIMETER.[1]

BY CHARLES L. NORTON.

THE utility of an apparatus which would enable an engineer or one not especially skilled in the manipulation of delicate physical apparatus to determine within a limit of about one-half of one per cent. the calorific power of a fuel, is apparent. That such an apparatus has been up to the present time available, is open to question.

The calorimeter which I have designed and which has been developed and carefully studied by Messrs. H. W. Allen and W. E. Parsons, students in the Rogers Laboratory of Physics as their thesis, is of the class of which the Favre and Silberman calorimeter may be called the type. I have borrowed some details from the older forms of this apparatus. The apparatus is constructed as follows: An outer water jacket of nickel-plated brass serves to protect the calorimeter proper from irregular radiation losses. The calorimeter, of thin nickel-plated brass, is cylindrical in form, being about 12 cm. in diameter and 15 cm. high. It has a loosely fitting cover with holes for the inlet and outlet oxygen tubes and ignition wire. The calorimeter is separated from the jacket by an air space, its position being maintained by cork spacing pieces. A rotary stirrer, driven by hand or by a small motor, is placed as near the side of the calorimeter as possible. When filled, the calorimeter holds about 1,000 grams of water.

The combustion chamber is supported on three legs in the center of the calorimeter, and consists of a cylinder with its axis vertical. Its diameter is 5 cm. and its height is 7 cm. The top is a tight-screw cover, having at its center a glass window protected by mica from the heat below. The bottom is a hemispherical shell and is brazed on. It is penetrated



NORTON COMBUSTION CALORIMETER.

by the inlet and outlet oxygen tubes, each about 5 m.m. in diameter. The products of combustion on leaving the combustion chamber pass into a flat box with a spiral partition, and then into a helical coil of tube about three metres in length, and finally escape at the top into the air. The outer end of the tube for supplying oxygen is above the cover of the calorimeter, from which point it passes downward through the water, penetrates the lower part of the combustion chamber wall, turns upward and ends at the center of the chamber. All parts of the combustion chamber and tubing are of copper nickel-plated. The walls of the chamber itself are about one millimetre thick, and are gold plated on the inside.

It is to the receptacle for fuel, or burner as we will call it, that particular attention is called, as the successful working of the apparatus is largely due to this contrivance. A platinum crucible, with a hole in the center of the bottom, is slipped over the end of the supply tube in the center of the combustion chamber. At about half its height the crucible is divided horizontally by a disk of sheet platinum. This disk has a great number of fine holes near its edge, but it is not perforated near the center. Upon the center of this plate the sample of coal to be burned is placed. The disk fits into the crucible loosely and may be taken out for cleaning, a series of indentations made in the outside of the crucible serving to keep it in position. A tight cover, perforated with many fine holes, is made of platinum somewhat thinner than the crucible walls. The upper parts of the crucible walls are perforated with fine holes. A fine platinum wire, heated by a current, serves as a fuse. It is insulated from the crucible by mica washers, and ends in stout insulated terminals in the walls of the combustion chamber

The manipulation of the apparatus is as follows: The weights of the coal, calorimeter and contents should be taken. The coal is put upon the perforated plate, the fuse put in place, the crucible cover put on, the crucible slipped over the end of the supply tube, the fuse connected to its terminals, the cover of the combustion chamber screwed on, the chamber put in position in the calorimeter, water poured in to immerse the chamber, and the whole put into the water jacket. The fuse is then ignited and the oxygen turned on. The thermometer readings complete the observations. Stirring should be maintained rigorously throughout the entire temperature change.

The oxygen should be saturated with water at a temperature about that of the initial temperature of the calorimeter. To burn one gram of coal requires two or three minutes, and necessitates the use of not more than one-half of a cubic foot of oxygen. It may be shown that the maximum error due to the rise or fall in temperature of the gas and to evaporation or condensation of moisture, cannot exceed one-third of one per cent.

The lightness and good conducting power of the platinum crucible and plate, assure their being at a high temperature during combustion, and to this is due, in my opinion, the completeness of combustion. No trace of carbon monoxide, and no indication of soot is to be found in the resulting gases. The stream of oxygen on entering the crucible strikes the intensely hot plate, and rising through the perforations passes in fine streams close to the pile of powdered coal, an ideal condition for completeness of combustion.

The use of the finely perforated walls and cover of the crucible assure the fuel being kept within the intensely hot receptacle until consumed. In no case has there been any trace of unburned fuel inside or outside of the crucible. To the rigor of the combustion, assured by the construction of the burner, is largely due the speed of the operation. This assures a small cooling correction. A rise of from six to eight degrees has a corresponding cooling correction of about two one-hundredths of a degree.

The results obtained with this calorimeter, when used upon coals of medium softness or upon very hard coals, agree within about one per cent. with the results on the same coals obtained with the Mahler combs. The results agree with one another to within one-half of one per cent. The experience thus far with the apparatus is limited, but leads me to hope that a study of the existing errors may result in an increase in the accuracy of the results to about one-tenth of one per cent.

[1]Abstract of a paper read before the Amer. Assoc. Adv. Sci., at Detroit.

THE PREDETERMINATION OF THE REGULATION OF A TRANSFORMER WITH NON-INDUCTIVE LOAD.

BY FREDERICK BEDELL, R. E. CHANDLER and R. H. SHERWOOD, JR.

To determine the regulation by this method a wattmeter, ammeter and voltmeter are located in the primary circuit. One set of readings is taken with the secondary short-circuited by a stout copper wire, the primary voltage being adjusted until the normal full-load current flows in the transformer or any desired fraction of it. No other data for obtaining a complete regulation curve is required, except the one set of readings above mentioned and the magnetizing current. If a wattmeter reading is taken when the magnetizing current is measured, the data is sufficient to plot a complete efficiency curve, as well as curve for the regulation of the transformer. The two sets of measurements then consist of the reading of a wattmeter, voltmeter and ammeter, first on short-circuit with normal current, and, second, on open-circuit at normal voltage. The wattmeter reading in the first case gives the copper losses; in the second case, the core losses.

It is commonly convenient to use the high-potential coil as primary in the short circuit measurements and the low potential coil as primary in the open circuit measurements. A high potential supply is not then needed, and as no power is required except to supply the

[1]Abstract of paper presented at the Detroit meeting of the A. A. A. S.

losses, the complete test of a transformer may be made with an incandescent lighting circuit for the source of supply, a 50-light transformer being tested from one 16 c. p. lamp socket. The total drop is found by laying off in the proper manner the inductive drop, the magnetic leakage drop and the drop due to ohmic resistance.

The method is theoretically an almost exact one. Practically, it is an exact method and less likely to error than the ordinary method of determining the regulation of a transformer by loading it. The results given in this paper from a long series of tests on seven transformers of various makes, show the reliability of the method, the secondary voltage at full load determined by it, varying usually less than one or two-tenths of a volt from the voltage as found by measurement on the transformer when actually loaded. An approximate method (given by Kapp) used by one of our large electrical companies gives less accurate results.

MECHANICAL

UTILIZATION OF EXHAUST STEAM.[1]

BY GEORGE L. THAYER.

IN four-fifths of the electric light stations we are wasting a by-product of greater relative value than is the case with any other industrial concern. The exhaust steam carries away 85 per cent. of the heat supplied by the boilers. The problem confronting the station manager of the day is this, Can this stream of energy now being wasted be put to some use, and, if so, will it pay to do it? This question can hardly be answered off-hand, but I wish to say that, generally speaking, there is no extension of your business that will pay larger profits on the investment than that of steam heating.

The author then gave brief descriptions of the gravity and vacuum systems of steam distribution, and mentioning the American District Steam Company, of Lockport, N. Y., as the pioneers in central station heating work.

It may seem strange but it is an actual fact that a gravity plant can be changed into a vacuum system and the coal consumption reduced considerably and that, too, with better results in heating. When the boiler feed-water is of a bad quality it will pay to return the water of condensation. Where a good grade of cylinder oil is used there will be no difficulty with the very small amount of oil coming from the heating system. There will be enough fresh feed-water added to prevent any trouble which would come from using distilled water in the boilers. It is needless to say that corrosion and scaling, with their attendant expense, will be largely reduced. However, the loss through wasting the condensed water is not as great as may seem at first. The condensation can be led into an indirect radiator and used to heat the fresh air from outside. The water leaving the coil will have all available heat removed. If, on the other hand, the condensation at 212 degs. be returned to the boiler the radiation loss in the returns may be more than the heat wasted when the water is discharged from the system.

The correct design and construction of the underground mains is a vital point if the system is to be made a success. It is necessary to secure three results. The radiation losses must be small; unless the distance run is excessive they should fall within 5 per cent. of the total system supplied. Expansion and contraction should be provided for. Assuming a range in temperature from 50 to 212 degs., 100 feet of main will expand 1⅜ inches. In a long line of pipe this becomes a serious matter. The mains should be protected from surface water as the pipes are soon corroded through when the pipe covering becomes damp. One standard method of construction is as follows:

At the bottom of the trench is laid a tile drain. Pine logs are bored and the outside surface painted with asphaltum. These are tenoned together and the iron pipe having received its covering is placed inside. Expansion is provided for by a special fitting having a flexible diaphragm doing away with a stuffing box. Service connections are made every 50 feet. The work is simplified by there being no return pipe.

Another method which seems to be successful is to build a box of tarred boards. The pipes are supported a few inches above the bottom of the box to protect them from water which may accumulate at the bottom.

The box is filled with asbestos wool or each pipe is covered with common pipe covering. Expansion is provided for either by expansion joints placed in manholes or, where the pipe is small, by U-shaped offset loops. Whatever method is followed it pays in the long run to have the work well done.

I am indebted to Prof. R. C. Carpenter, of Cornell University, for the following data on condensation in steam pipes: The various university buildings are heated from one boiler plant through underground mains. The pipes are laid in a solid log bored 2 inches larger than the pipe. The thickness of the wood remaining is 4 inches. The logs were painted on the outside with coal tar and sawdust. There is in the system 150 feet 10-inch pipe and 2,050 feet of 6-inch pipe, having a total heating surface of 5,605 square feet. The temperature difference was 235 degs. Twenty-seven h. p. of return steam was required to supply condensation, i. e., 1 h. p. loss for each 820 feet of 6-inch pipe, or its equivalent surface, 1 h. p. being taken as 30 pounds steam at 70 pounds pressure with feed-water at 100 degs. In a more technical form the heat loss .614 B. T. U. per square feet for each degree difference in temperature. With what is considered good practice at the present time the radiator losses can be reduced to 40 per cent. of these figures.

There is no hard and fast rule for the proportioning of radiating surface. Of two buildings of the same construction apparently, one will be warm and the other cold. The formulæ given in text-books are quite complex and involve considerable labor. The method used by a firm in the West which gave good results with a minimum of work, is as follows: The glass surface was figured, first taking total opening of window frame to allow for leakage. The exposed walls were figured and reduced to equivalent window surface. For unfurred brick or stone walls 15 ins. thick 4 square feet was taken as the equivalent of 1 square foot of glass. For ordinary wooden dwellings and furred brick walls the ratio was 1 to 6. Extra warm construction was 1 to 8. For northern Illinois the required heating surface was 1 square foot for 2 square feet of glass. Rooms exposed to northwest winds the radiator surface was increased 10 to 15 per cent. Any unusual conditions were allowed for as experience suggested. Radiator was proportioned to maintain 70 degs. inside with 0 deg. weather outside.

The rates and methods of charging for central station heating vary considerably. There is a tendency to charge according to the space to be warmed rather than by square foot of radiation. For a store 20 x 80 x 14 the charge for heating is about $60. The radiating surface required is in the neighborhood of 250 square feet, or 25 cents per square foot heating surface per year. Such a store will use 5 to 7 tons of hard coal in an ordinary winter. At $7.50 per ton it will cost $45 to $50 per year for heating.

You are selling heat practically in competition with hard coal, and the rates you are able to secure will be based on that method of heating. In the territory covered by this association you ought to get from 10 per cent. to 20 per cent. more than the cost with hard coal. You can offer a much better manner of heating but with the disadvantage of the cost of the radiators and piping. The following are some examples of rates:

Plant 1.—Storeroom, 20 x 90-100, $60 to $70; office, 15 x 20, $20 to $25; bank, 20 x 30, $40 to $50.

Plant 2.—Store, 22 x 60, $50; 22 x 75, $62.50.

Plant 3.—$15 per 100 feet per year, or $2 per 1,000 cubic feet in brick stores; $3.50 per 1,000 cubic feet in dwellings.

Plant 4.—$100 to $125 for ten-room house.

Plant 5.—$0.25 per square foot per year.

Plant 6.—$3.50 per 1,000 cubic feet; heating done by live steam on meter.

As yet there is no meter on the market except that of the American District Steam Company, which is used only on their plants.

The cost of operation outside of interest and depreciation charges will naturally vary greatly in different plants. It should be borne in mind that your profit lies in selling exhaust steam rather than live steam. An increase in business beyond a certain point may not pay if fuel is high and the heating rates are low.

One foot of radiating surface will condense ⅓ pound of steam per hour. Assuming that five and one-half months' steady heating will be the equivalent work for one season, coal at $2 per ton of an evaporation power of 7 pounds, the fuel cost will be 19 cents. If the revenue from 1 foot will be 25 cents, it will probably be found that business does not yield any profit. In the stations of towns of less than 15,000 inhabitants, 75 per cent. of the maximum evening load will be carried for five hours during the heating season. Outside

[1] Read before the Northwestern Elec. Assoc. Abstract.

of these hours the load will run about 30 per cent. for the remainder of the lighting hours. The day power load, if any, will hardly exceed the all-night load. The conditions will be that on the first floor 50 per cent. of heating business can be done with exhaust steam for at least fourteen hours per day. The fuel cost of live steam furnished will be 11 cents per square foot. Another 45 per cent. can be supplied with exhaust steam five hours per day at a fuel cost of 15 cents per season. This would indicate that the profitable heating is that which can be taken care of during the greater part of the evening load. Cost of fuel will determine in each case whether new business will pay on a live steam basis.

Some modifications of central station design will follow when steam heating is added. The boiler portion of the plant becomes of much greater importance. Wastes which otherwise would be small assume greater importance when the work done by the boilers is more more than doubled. Every effort should be made to bring them up to the highest efficiency. The installation of auxiliary devices as "Green's Economizer" will sometimes be advisable.

The use of storage batteries in connection with a heating plant assumes a new importance. It can safely be assumed that during the hump of the load more steam will be used by the engines than can be discharged into the heating system. A storage battery can be used to take a portion of the load during the time. Later in the night when the heating must be done in part with live steam it can be charged at a very small expense for fuel. Assuming boiler pressure 100 pounds, and temperature of water from heating system at 180 degs., 1 pound of steam entering the engine becomes .9 pound at exhaust by adiabatic expansion, a loss of 10 per cent. The steam at atmospheric pressure and weight for weight as compared with steam at boiler pressure contains 4 per cent. less heat. There will be available then 86 per cent. of the heat entering the engine. Engine friction and the loss by external condensation remain practically constant. Internal cylinder condensation is slightly less with the added load. Approximately the battery can be charged with 15 per cent. of the fuel required under ordinary conditions. When conditions are suitable there will be a marked gain by their use.

In alternating plants it will be necessary to provide a direct current load during the heavy lighting hours if batteries are put to this use. A power load would probably be quite small after 6 p. m. Long burning arc lamps could be installed very successfully in this connection. In this case a good construction would be made with a 220-volt power current and a three-wire system for the arc lamps. Close regulation not being necessary, considerable complication due to cells and boosters could be avoided.

The generator might in some cases be used as a motor during the heavy lighting load, in the absence of an arc light or power load for the batteries.

To offset these advantages is the high cost of the battery and unwillingness of the smaller stations to make large increase in their investment for the sake of economical operation.

Once a heating system is in operation, it becomes a much easier matter to secure paying power or day lighting load. During the heating season the machinery can be run at a small additional expense, the principal items will be oil and the increased wear and tear. With the coming of the warm months a respectable fan motor business can be worked up, which will tide over the summer months when the station must be run day time for power alone.

LITERATURE

DIE STAATSTELEPHONIE IN WURTTEMBERG.—(Government Telephony in Wurtemburg.) By A. Hassler. Stuttgart; W. Kohlhanner. 1897. 142 pp.; 6 x 9 in. 15 plates: Paper. Price, $1.50.

This is a strictly technical and accurate account of the telephone system as it exists at the present time in Wurtemburg, Germany. The author has omitted no single detail, from the telephone receiver to the switchboard, giving in full descriptions and illustrations of the various apparatus employed, both at the exchange and at the subscriber's end of the line, with the complete diagrams of circuits, switchboards, test board, etc. While we believe that the best American practice is ahead of that shown in the volume before us, there is nevertheless enough interesting matter contained in the present volume to make its perusal by American telephone engineers desirable. The administrative details contained in the work might also contain some useful hints to telephone managers.

LETTERS TO THE EDITOR

ARE TWO SAFETY FACTORS BETTER THAN ONE?

THE criticism by Doe Bird in The Engineer of August 5 on Jim Crow's recent article on insulated iron armored conduit is so utterly absurd that it is almost superfluous to reply to it. Doe Bird is evidently not one of the "Babes" out of whose mouths an all-wise Providence has ordained strength, but is apparently another case of a "fool asking questions," etc. There is surely reason in the assumption that the people who make rules for electrical, or any other construction, have at least a superficial knowledge of the character of the work they seek to regulate.

If it is Doe Bird's intention to assume that insulation is not a prime factor in electrical construction, he leaves no room for argument, but he inspires a boundless sympathy for his solitude. In these up-to-date times there would seem to be no good reason why allowance should be made for "habit," "fog" or anything else but fact, and if it is not a fact that two safety factors are more effective than one, it is certainly time that the engineers of the world were so informed. In almost every branch of house construction, materials are so placed as to support and supplement each other, and it is doubtful if an engineer can be found who is willing to risk the operation of a large factory upon a single engine, boiler or dynamo unit. Why then should the service of an electric plant, or the safety of life and property be left dependent upon a single unit of insulation; especially one of a value undeterminable at the time of its installation, and subject to more or less rapid deterioration thereafter? An examination of ordinary rubber-covered conductors which have been in service for a few years, will demonstrate how supremely ridiculous is the assumption that the "wires of commerce" are so insulated as to secure a "reliable and durable service" if installed in plain iron conduit. Those who want, and are willing to accept proof that such assumption is not well founded, can readily obtain it by a few very simple experiments. The proposition that the insulation of a conduit adds nothing to its efficacy as a safeguard against fire, is a difficult one to understand, and is about as logical as the statement that one two inch stream of water would be as effectual in putting out a fire as four half-inch streams. Neither proposition will admit of argument.

There are those possessing that dangerous thing "a little knowledge," who think that conduits should be insulated for conductors carrying currents of high voltage, while plain iron pipe may be safely employed for conductors carrying currents of low voltage. Experiments will effectually demonstrate the error of this assumption by producing a fire from a current of about three amperes at 110 volts, employing a conductor with defective insulation in a plain iron pipe. A like experiment conducted under the same conditions, but with an insulated armored conduit, will produce nothing but the most conclusive evidence that after the insulation on a conductor has broken down and lost its saving power. Doe Bird's argument is as much out of season as the bird under whose name he writes, while the property owner is yet a long way removed from the doubtful pleasure of entertaining the press boys and insurance adjusters with an account of his losses, and how it all happened in spite of high class workmanship, done in strict compliance with the rules and regulations of the fire underwriters. Perhaps Doe Bird is slyly joking after all.

Your correspondent from the West, writing under date of August 12, suggests that Jim Crow does not properly conceive the function of iron pipe or iron armored conduit as viewed from the point of one who has the prevention of fire in mind, and apparently in support of this conclusion, he informs us that "high insulation is not necessarily a protection against fire," also that he has known of lightning discharges breaking through good rubber insulation and air gap.

The gentleman from Cincinnati might truthfully add that lightning discharges have been known to pass through brick walls, feather beds, army mules and countless other things having no special connection with the subject under discus-

sion, but admitting the truth of these freaky movements of untrammeled lightning out for a good time, there seems to be room for a reasonable degree of doubt as to the accuracy of the gentleman's statement that "high insulation is not necessarily a protection against fire" caused by the average currents and voltages used in interior electrical construction, although he is no doubt approximately correct if he has in mind the placing of lightning rods and other superlatively high tension conductors in iron armored conduit or plain iron pipe. In order that there may be no further misapprehension on this point, however, it should be stated that throughout this discussion the writer has referred only to conduits for conductors carrying currents having an e. m. f. of not more than 300 volts.

But to get back to the earth and things that are of the earth, there appears to be at present little cause for fear regarding the ability of electrical engineers and manufacturers to produce insulation, that if used for low tension conductors placed in insulated iron armored conduits, will be a reasonably good protection against fire. The second paragraph of the letter from Cincinnati contains a sentence worded as a proposed requirement for iron conduit construction with which contractors might possibly have some slight difficulty in complying, viz.: "The piping must be electrically continuous and heavily grounded with a ground of carrying capacity equal to that of the largest wire in the system." It is probably safe to say that the ground of a conduit system is seldom of equal value for any considerable length of time, and even if it were possible to maintain indefinitely atmospheric conditions of equal density, it would be necessary to invent a conduit coupling that would permanently retain an electrical connection having a given current-carrying capacity. If anyone has knowledge of such an invention, it is his duty to make it known now, then after such a joint is perfected the permanent atmosphere should be advertised for.

It would be exceedingly interesting to hear from some of the electrical contractors who occasionally install conductors of from one to three million circular mils regarding this proposition to produce on their iron conduits, a ground connection, continuous the entire length of the tube and having current carrying capacity equal to that of the largest conductor of the wiring system. Let the contractors or engineers of the Astoria, Siegel-Cooper, St. Luke's Hospital or some other installations of about the same size, tell us how they would like to work under such a rule and how they would endeavor to comply with it.

The question of the strain on the insulation of a conduit being always constant at the bend seems to be a regular old stand-by, and is used, perhaps for want of a better argument, by almost every advocate of plain iron pipe, while almost with the same breath most of them claim that such pipe should have a thin coat of varnish, paint or enamel which, by their own argument, will not last in a bend while ten feet of wire are being drawn over it, and under the best conditions will not last nearly as long as the thick, strong, solid interior lining that is used at present, and which, if the pipe is large enough, will withstand the drawing in and out of all the conductors that will ever be placed in the conduits of which it is a part.

Most of the arguments that have recently appeared against the use of insulated iron armored conduit, refer directly or by implication to ancient history, viz.: an unsuitable lining, without sufficient mechanical strength and unable to withstand a temperature of more than 75° F., whereas the product of to-day is mechanically strong, will withstand without injury the drawing in and out of conductors as often as may be desired, and will be uninjured by a temperature of at least 500° F.

Engineers and contractors would do well to look into these matters carefully before placing too much reliance on the misleading statements of those who, unwittingly or otherwise, misrepresent the true condition of affairs, and who at least show a lack of familiarity with the character of the goods at present on the market. If it is wise to leave the selection of plain or insulated conduits to the discretion of the engineer, it is equally wise to leave every other question connected with electrical installations to the same discretionary power, and there should be only two underwriters' or other rules, viz.: Rule No. 1. All electrical conductors and appliances must be so installed as not to incur a fire risk. Rule No. 2. All electrical conductors and appliances must be so installed as to render personal injury impossible.

There is the sum and substance of the entire code with the details of construction "wisely left to the discretion of the engineer."

Of course it does not at present appear how such a proposition would apply on installations that are placed without the services of an engineer or how it would fare in the hands of an engineer who did not use discretion, but these are small details that would doubtless work out all right in time.

Manufacturers of anything on earth should certainly not be allowed to influence the decisions of Inspection Bureaus except as such bureaus may be influenced by having before them samples of every electrical appliance used under their rules, and assuming the knowledge that such familiarity with the market would imply their approval of any two articles, simply because they were to be found on the market or because one was cheaper than the other, though not as good, nor as safe, would seem to indicate almost anything under heaven except a "spirit of fairness."

Underwriters should be fair to everybody, but first of all to the insured public who pay the fire losses, for, although it may not occur to the average citizen, it is nevertheless a fact that fire losses are paid neither by the underwriters nor by the insurance companies, but by the insured public, whose premiums are large or small in proportion to their supposed fire risk, and who should be given, irrespective of the cost of materials, the best protection from fire which human ingenuity can devise. If "Bald Eagle" will look more carefully he will find, in all the wiring rules at present in existence in this country, many more inconsistencies than those he quotes, but if he employs the entire Lick Observatory, he will fail to find any rule which requires the use of a switchboard of any kind whatever.

As the rules now read he may assemble his apparatus on a switchboard, thereby greatly decreasing both fire and personal risk, or he may distribute his switches, instruments, etc., throughout a building, so that in case of trouble the building can be burned up before the operator can reach his controlling devices and indicators, much on the same principle as installing a boiler and engine in the sub-basement and putting the steam gauge and throttle valve up on the twenty-fifth floor. If there were good electrical reasons for the adoption of plain iron pipe instead of insulated iron armored conduits as raceways for electrical conductors, there would be no hesitation among fair-minded electrical men as to its use, but if it is to be used merely to reduce the cost of installations, at the expense of reducing their efficiency and insulation value, it can only retard the progress of the art without having anything to commend it in the premises.

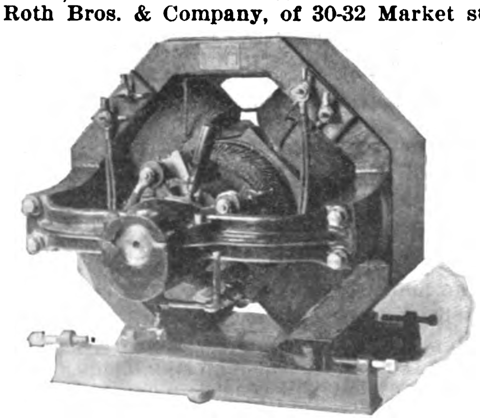
JIM CROW.

New York, Aug. 30, 1897.

NEWS AND NOTES

THE ROTH MULTIPOLAR DYNAMO.

ENCOURAGED by the unqualified success of their bipolar dynamos, now manufactured for a number of years, Messrs. Roth Bros. & Company, of 30-32 Market street, Chicago, Ill., have recently designed and placed on the market a line of multipolar generators and motors. These machines embody all the latest advances in dynamo construction and possess a number of special features, which merit investigation.



THE ROTH MULTIPOLAR DYNAMO.

The armature is of the hollow drum type, the core being built on a cast iron hollow cylinder easily removable from the shaft. The core discs, varnished for insulation before being

put together, are held between two solid cast iron end plates, the clamping bolts passing through the inner space of the hollow drum. This method of construction avoids holes through the core discs, thus giving a uniform magnetic path in the armature. The armature coils are wound on a form, taped with silk tape, varnished and baked before being placed on the core. The parallel grouping of armature construction is employed, which in connection with a special system of commutator connections greatly facilitates the repair of the armature.

In case a coil has to be removed, this may be done by simply loosening the two armature connectors of which the coil forms a part, whereas in general, in a four-pole machine at least one-half or even all the connectors have to be unsoldered.

The commutator has a liberal collecting surface as well as wearing stock and a large number of sections. Carbon brushes are used on all machines of 110 volts and over. The brush holders are of the tangential reacting type, the commutator surface moving in a direction opposite to the pressure of the springs. Each brush holder contains a number of square carbons, each pressed against the commutator by a spring. The tension of the springs may be adjusted and the carbons removed while the machine is running. These brush holders are among the simplest and most efficient yet devised.

The field frame is of the radial external pole type, which form has met with general approval during late years. The yoke is broad and entirely protects the field coils. The field cores are annealed wrought iron with circular section, which combines a maximum economy in the work of winding and the material of the field coils. The bearings are self-oiling, self-aligning and provided with oil gauge and cock.

From the foregoing description it will be seen that great care has been exercised in the design to produce a machine entirely reliable in operation and with all wearing parts interchangeable. The machines are wound either as generators or motors for 110, 220 and 500 volts, or special voltages. The generators are adapted for lighting, power transmission and electro deposition. When intended for lighting and general distribution they are accurately compounded and are self-regulating at constant speed. The rise of temperature of armature and field coils is well within the limit generally prescribed in dynamo specifications, and in regard to efficiency and operation the machines compare favorably with the best in the market.

BOSTON.—A school of electrical instruction has been established at the fire department headquarters, for the firemen, etc., under Drill Master Kinney, who is supervised by Mr. W. Brophy.

A TELEPHONIC AFFIDAVIT.—Record is made in the daily newspapers of August 31 of the receipt in New York City by telephone of an affidavit from Minneapolis. The sending of the affidavit by telephone was corroborated by a telegraph message sent for the purpose.

SOCIETY & CLUB NOTES

EDISON CONVENTION AT NIAGARA FALLS.

As already announced, the meeting of the Association of Edison Illuminating Companies will be held at the Cataract House, Niagara Falls, Sept. 14, 15 and 16.

The meetings of the convention will be held in the large ball room of the hotel. The sessions will be called to order at 10 A. M. each morning, commencing with Sept. 14, and 8 P. M. every evening, ending Sept. 16, the afternoons of the three days being devoted to the entertainments. The programme of the convention will consist of papers and discussions upon methods of charging for current, construction and practical use of the photometer as applied to the gas industry, storage batteries, economy in distribution of electrical energy, recent developments in electrical measuring devices, besides reports of various committees and Lamp Testing Bureau. The entertainments will comprise a visit to the power house of the Cataract Construction Company, a ride through "The Gorge" on the new electric road, tally-ho ride, etc., etc. A large number of favorable replies to the former notice of the secretary has already assured a very large attendance, in fact the convention promises to be the most successful one in many years.

PENNSYLVANIA STREET RAILWAY ASSOCIATION.

The above society held a good meeting at Allentown, Pa., on September 1 and 2, when nearly 100 members and supply men were in attendance. The following officers were elected: President, Robert E. Wright, Allentown; first vice-president, Frank Silliman, of Scranton; second vice-president, Dallas Sanders, of Philadelphia; secretary, S. P. Light, of Lebanon; treasurer, William H. Lanius, of York; Executive Committee, Robert E. Wright, Allentown; Simon P. Light, Lebanon; B. F. Meyers, Wilkesbarre; E. C. Felton, Harrisburg, and John A. Rigg, Reading. The convention will meet at Scranton next year. Dallas Sanders, of the Philadelphia bar, delivered an address on "Street Railway Legislation in Pennsylvania," exhaustively presenting the history of street railway transit and of the laws pertaining to this method of travel.

COLUMBUS, O.—The Ohio Association of Independent Telephone Companies, which includes some seventy-two companies in Ohio and Indiana, held a meeting on August 27, discussing plans for the extension of toll lines, etc.

PERSONAL

MR. A. J. GUERNSEY writes us that Mr. Henry Cottle has been appointed consulting electrical engineer of the Boston Fire Department, being already chief of the electrical division of the Public Buildings Department. He has had charge of the work of an electric light plant for the City Hospital, on which some $40,000 has already been spent.

MR. GEORG KIRKEGAARD, of Tompkinsville, L. I., has devised an electric trap for rats, which, with live chickens for bait, has disposed of as many as 123 of the rodents in a night. The chickens do not get used up, but the rats do. The trap doors are controlled by electricity.

MR. G. W. BEERS, of Fort Wayne, Ind., was a visitor to New York last week. He is interested in the independent telephone movement, and regards the outlook as bright.

MR. SETH C. ADAMS, on his retirement from the Bossert Electric Construction Company, Utica, has been presented by the factory staff with a handsome gold watch chain and charm as a remembrance of the pleasant relations that had existed.

MR. E. J. WESSELS, general manager of the Standard Air Brake Company, returned by the Lucania on the 27th of August after a three months' business trip abroad, during which time he visited the street railway convention in Hamburg. The Standard Air Brake Company have closed several important contracts for their various types of apparatus.

MR. L. M. ERB has resigned his position as manager of the Leavenworth, Kan., Electric Railway Company, with which he had been connected from the start. Mr. E. C. Combs is to act as manager for the present.

THE STOCK MARKET

GENERAL CONDITIONS BETTER AGAIN.

It has been thought by many that the recent advances in the price of staples and in stock quotations have been too rapid, but there is little evidence of the truth of that idea. On the contrary, the way in which the general strength is sustained is most remarkable. Wheat keeps around the dollar mark; iron and other staples have hardened in price; railroads report large increases in earnings, and the stock market has seen some sensational advances again.

During the past week, 94,778 shares of Western Union were sold at 93¼ up to 95¼. On sales of 41,310 shares, General Electric advanced to 39½, closing at 38⅛. American Bell Telephone has made a really phenomenal jump to 267.

JACKSONVILLE, FLA.—Plans are being prepared for an addition to the city's electric light plant. It is proposed to build an extension 28 x 30 feet to the south end of the present building. This will furnish ample room for the extra dynamo, if it shall be decided to make the extension.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 24, 1897.

Alarms and Signals:—

ELECTRIC BURGLAR ALARM. H. M. Dumas, Detroit, Mich., 588,695. Filed August 24, 1896.
The buildings are connected to a central office by a normally closed circuit and the signaling apparatus is placed in a shunt circuit.

ELECTRICAL INDICATOR FOR VALVES. W. J. Rickard, Philadelphia, Pa., 588,880. Filed October 31, 1896.
Details of construction.

Batteries, Primary:—

ELECTRIC BATTERY. Wm. Mills, Elizabeth, N. J., 588,591. Filed November 30, 1896.
Embodies an insulating bushing detachably secured to the zinc element.

ELECTRIC BATTERY. W. Mills, Elizabeth, N. J., 588,592. Filed November 30, 1896.
Similar to above.

Batteries, Secondary:—

ACTIVE MATERIAL FOR ELECTRODES OF ELECTRIC ACCUMULATORS. S. Hammacher, Berlin, Germany, 588,905. Filed August 28, 1896.
Contains a compound of lead oxid and a member of the pyrid in series.

Distribution:—

ELECTRIC LIGHTING SYSTEM. F. W. Lord, Boston, Mass., 588,683. Filed June 19, 1897.
Employs a two-way switch, and a two-way lamp socket connected at two corresponding points to the two-way switch, and connections from a third point on the socket and on the switch to the mains of the system.

Dynamos and Motors:—

DYNAMO ELECTRIC MACHINE. L. C. Rice, St. Louis, Mo., 588,602. Filed November 4, 1896.
Comprises a stationary armature, and field magnets, a rotating inductor magnet having poles of opposite polarity magnetically insulated from each other, and a casing completely enclosing them.

ARMATURE FOR INDUCTION MOTORS. A. L. Cushman, Concord, N. H., 588,692. Filed August 15, 1894.
Applies to armatures wound with magnetizing coils, each forming in itself a separate closed circuit not connected to an electrical source.

Electro-Metallurgy:—

APPARATUS FOR TREATING GOLD AND SILVER ORES. B Becker, Eupen, Germany, 588,740. Filed February 5, 1897.
Comprises a vat having a bottom of conical form, means for injecting liquid into the vat through its bottom and a distributing device to distribute the liquid laterally and spirally.

PROCESS OF MAKING LITHARGE OR PROTOXID OF LEAD FROM LEAD ORE. P. G. Salom, Philadelphia, Pa., 588,883. Filed June 29, 1897.
Consists in subjecting the ore to the action of nascent hydrogen electrolytically developed, producing thereby a spongy mass, then heating the spongy mass in the open air first at a temperature below the melting point of metallic lead and afterward to a higher temperature.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. T. Spencer, Philadelphia, Pa., 588,610. Filed November 16, 1896.
Enclosed arc lamp for alternating currents.

INCANDESCENT LIGHTING SUBSTANCE. W. Mahler, New York, 588,685. Filed July 10, 1897.
A mantle or hood composed of a large percentage of cerium oxid and a smaller percentage of lanthanum oxid.

ELECTRIC ARC LAMP. B. F, Greene, Sheridan, Pa., 588,822. Filed April 22, 1897.
Feed mechanism for enclosed arc lamps.

INCANDESCENT ELECTRIC LAMP SUPPORT. E. L. P. Wetmore, Marquette, Mich., 588,890. Filed March 13, 1896.
The lamp is suspended from a carriage movable on metal tracks connected with the current.

Miscellaneous:—

IGNITER FOR EXPLOSIVE ENGINES. L. Bly, Decatur, Ill., 588,629. Filed December 26, 1896.
Details of construction.

MEANS FOR SUPPORTING ROTATING SHAFTS. W. Stanley and F. Darlington, Pittsfield, Mass., 588,666. Filed May 5, 1897.
Comprises a rotatable shaft of magnetic material and a magnetic system producing a magnetic flux symmetrical and in supporting relation thereto.

ELECTRIC WICK LIGHTING DEVICE. H. Van Hoevenbergh, New York, 588,669. Filed May 5, 1896.
Igniter for central draft lamps.

ELECTRICAL KEG REGISTER. W. Kraft, Baltimore, Md., 588,797. Filed June 1, 1897.
Apparatus for counting kegs as they are taken from a cellar.

MEANS FOR MANUFACTURING CARBIDS. J. W. Keneval, Chicago, Ill. 588,866. Filed February 1, 1897.
Consists of a suitable casing within which are a pair of rotatable electrodes arranged in a horizontal plane, mechanism for rotating them and for connecting the electrodes with a source of electricity.

ELECTRICALLY OPERATED SHIP-CLEANING DEVICE. E. T. Thomas, New York, 588,933. Filed April 21, 1896.
Comprises an arched frame supporting electric conductors, a truck provided with wheels for holding a portable, suspended motor and tools operated by the motor.

Railways and Appliances:—

STATION INDICATOR FOR TRAMWAY OR OTHER CARS. H. W. Langschmidt, Brooklyn, and R. F. Le Brocq, New York, 588,701. Filed October 16, 1896.
Details of construction.

ELECTRIC CONNECTION BETWEEN RAILWAY RAILS. F. Marseilis, Peralta, Cal., 588,771. Filed May 13, 1897.
Consists of a curved elastic steel plate, having the ends bent to one side and adapted to engage with the rail ends and a means for clamping the plate in place.

ELECTRIC RAIL BOND. W. B. Cleveland, Cleveland, O., 588,791. Filed April 15, 1897.
Consists of an oblong frame formed from a laterally compressed coil of flat wire coiled to have its flat sides bearing against each other, and terminal heads and lugs cast upon the doubled ends of the frame.

TROLLEY WIRE HANGER. G. E. Johnson, Los Angeles, Cal., 588,923. Filed June 5, 1896.
Device for connecting the wires that can be applied without soldering the connections to either the supporting wire or the trolley wire.

Regulation:—

ELECTRICAL TRANSMISSION OF POWER. E. Lanhoffer, Mulhausen, Germany, 588,831. Filed June 20, 1895.
Means whereby the motors are capable of gradually altering their rotary speed, in contradistinction to a step-by-step variation of speed.

Switches, Cut-Outs, Etc.:—

ELECTRIC CUT-OUT. M. Marshall, Boston, Mass., 588,686. Filed May 29, 1896.
Consists in creating a substantially large air pressure by the heat generated by the melting of the fuse, and causing the same to pass in a smaller amount across the plane at a different point from that at which the pressure is created.

Telephones:—

COUNTING AND SIGNALLING APPARATUS. B. E. Waters, Brockton, Mass., 588,670. Filed February 8, 1897.
Designed to record the number of times a telephone is used.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 31, 1897.

Alarms and Signals:—

FIRE ALARM. J. W. Arnold, Otsego, Mich., 588,942. Filed April 29, 1897.
Comprises a tower and bell and spring actuated mechanism to sound the alarm when released by an electro-magnetic device.

MUNICIPAL SIGNAL SYSTEM. H. F. Eaton, Cambridge, Mass., 588,965. Filed November 24, 1888.
Adapted to operate an audible alarm or indicating signal for some of the signals and not others.

ELECTRIC ALARM AND CALL BELL. F. C. Jordan, Wadsworth, Ohio, 588,997. Filed January 11, 1897.
Employs a clock and devices whereby the connection of the contact-finger with the hour hand may be utilized to ring a series of bells at determinate places.

RAILWAY SIGNAL. C. W. Grant, Concord, Mass., 589,170. Filed November 19, 1896.
Employs coils placed along the road bed, operated by a locomotive on one section to sound an alarm in the cab of an interfering locomotive on another section, by means of induction.

Batteries, Secondary:—

STORAGE BATTERY. W. J. Still, Toronto, Canada, 589,042. Filed February 10, 1896.
The electrodes are formed of a rectangular spiral strip, the oxid being placed between the convolutions of the spiral.

Conductors, Conduits and Insulators:—

OUTLET BOX FOR GAS PIPES AND ELECTRICAL CONDUITS. W. J. Billings and M. Mauer, New York, 589,115. Filed June 7, 1897.
Embodies removable and interchangeable sides and a removable and interchangeable bottom plate.

PROCESS OF MAKING INSULATING MATERIAL. J. Gray and C. H. Case, South Manchester, Conn., 589,256. Filed May 16, 1896.
Consists in forming a mass of pulp to shape, heating the same in a bath of molten sulphur, and subsequently setting such article by immersion in a cold bath.

Distribution:—

MEANS FOR OPERATING GENERATORS AND STORAGE BATTERIES IN CONJUNCTION. W. Meredith and A. M. Hunt, San Francisco, Cal., 589,186. Filed September 8, 1896.
Comprises the combination of an auxiliary dynamo, storage battery and main dynamo, the armature of the auxiliary dynamo and the storage battery being connected in series and the two being in shunt, with the main dynamo.

Dynamos and Motors:—

BRUSH FOR DYNAMOS. F. J. Chapin, Birmingham, England, 589,162. Filed March 17, 1897.
Consists of sheets having the wires running diagonally and sheets having the wires running square with the length and breadth of the brush and with a wire center.

Electro-Metallurgy:—

APPARATUS FOR REFINING METALS BY ELECTROLYSIS. J. O. S. Elmore, Kapurthala, India, 589,251. Filed August 17, 1896.
Comprises a series of non-conducting frames carrying plates of crude material clamped together, and an electric circuit connected at its terminals to the lowest and uppermost sheet respectively.

APPARATUS FOR REFINING METALS BY ELECTROLYSIS. J. O. S. Elmore, Kapurthala, India, 589,252. Filed August 17, 1896.
Similar to above.

Electro-Therapeutics:—

ELECTRICAL BODY APPLIANCE. J. P. McGill, Chicago, Ill., 589,015. Filed February 23, 1897.
A flexible battery-belt comprising a plurality of continuously arranged galvanic couples.

Measurements:—

ELECTRIC METER. E. J. King, Fort Wayne, Ind., 588,999. Filed May 1, 1897.
Comprises field coils and a plurality of movable coils secured at an angle to each other upon a common axis within the field, connections

Miscellaneous:—

ELECTRICAL DENTAL FURNACE. C. A. Timme, New York, 589,-048. Filed March 14, 1896.
Composed of a casing of refractory material and removable heating plates independently connected with a source of electricity arranged at the interior of the muffle.

HARD BODY FOR RIFLING CHROMATED STEEL. F. Chaplet, Laval, France, 589,161. Filed September 15, 1894.
A very hard compound, consisting of carbon, titanium and silicium, in chemical combination.

ELECTRIC PIANO. J. L. Fulkerson, Kansas City, Mo., 589,347. Filed December 4, 1896.
Means whereby a piano may be operated from any desired point at any distance.

AUTOMATIC SWITCH FOR RAILROADS. L. A. Moore, Brooklyn, N. Y., 589,093. Filed April 10, 1897.
Embodies a weighted lever engaging with the switch-point to normally hold the switch open and electro-magnets to shift the lever when desired.

TROLLEY. A. O. Wyman, Turner's Falls, Mass., 589,109. Filed April 20, 1897.
Details of construction.

ELECTRIC CAR LIGHTING SYSTEM. F. M. Bennett, New York, 589,112. Filed January 4, 1897.
Comprises a dynamo actuated by the movement of the vehicle, a secondary battery, and a switch for directing the current to the secondary battery.

ELECTRIC HEADLIGHT. John Kirby, Jr., Dayton, O., 589,130. Filed February 15, 1897.
Details of construction.

Regulation:

ELECTRIC REGULATOR FOR DYNAMOS. W. H. Chapman, Portland, Me., 589,073. Filed April 4, 1896.
Voltage regulator. Details of construction.

Switches, Cut-Outs, Etc.

AUTOMATIC SWITCH FOR CHARGING AND DISCHARGING SECONDARY BATTERIES. A. S. Hubbard, New York, 589,-128. Filed October 23, 1896.
Details of construction.

TRADE NOTES & NOVELTIES

ELECTRIC POWER TRANSMISSION.

For ten or twelve years past the C & C Electric Company, of New York (works at Garwood, N. J.), have made a specialty not only of the manufacture of electric motors for every conceivable purpose, but have energetically been at work building up the electric power transmission business to such an extent that to-day they claim to have in operation more electric transmission systems than any other manufacturer of dynamos and motors. The C & C Company are still devoting considerable attention to making investigations of existing wasteful transmission systems in old manufacturing plants and submitting estimates of the saving which may be effected by the use of their power transmission apparatus. This company have recently taken several contracts for large systems of this kind and their years of experience in this work, as well the well known general excellence of their apparatus, insures that their customers will find entire satisfaction, as well as being able to effect considerable saving.

FULLER & CURTIS CO.

The Fuller & Curtis Co., Detroit, Mich., corner of Russell street and Boulevard, are the successors to the Fontaine Co. This new concern will manufacture the Fuller dynamos, motors and ventilating apparatus; also the Curtis hot blast apparatus for the heating of public buildings. The officers are Frank E. Kirby, president; Cameron D. Waterman, vice-president; Neil McMillan, treasurer; Rodolphus Fuller, secretary and manager, and W. H. Curtis, superintendent. They will be glad to receive inquiries as to all classes of dynamo and motor work, engines, boats, special apparatus, etc.

QUICK ELECTRIC COAL CUTTING.

The Jeffrey Manufacturing Company, of Columbus, Ohio, have received a report from James Cameron, superintendent of their No. 2 Western Coal and Mining Company's mine, located in Arkansas. Mr. Cameron states that at their mine with a Jeffrey electric machine, equipped with self propelling truck, they were able on August 13 to make 95 cuts in nine and one-half hours. This record was made by two of their men, all cuts being made with the same machine. This work was done in five rooms and two entries, and necessitated the changing of bits a number of times. It was necessary to load and unload the machine seven times. This run beats any record that has ever been made in the mine, and up to this date there has never been a report from any mine in the United States of such a record.

WARREN ELECTRIC AND SPECIALTY CO.'S LAMPS.

A contract for 10,000 lamps for the new Public Library, Chicago, has just been awarded to the Warren Electric and Specialty Company, Warren, O., who call attention to the fact in our advertising pages this week. They are pushing their business very briskly, and expect to do a very good trade. They offer lamps at low prices, and various candle-powers, in Edison, Westinghouse, Thomson-Houston, Brush-Swan, United States, Hawkeye, Schaeffer and Perkins bases, and will be glad to receive orders requiring prompt shipment.

ELECTRIC APPLIANCE CO.'S NEW CATALOGUE.

General Catalogue No. 12 of the Electric Appliance Company, of Chicago, has just made its appearance—a handsome, portly volume of nearly 600 pages, large octavo, bound in heavy red linen board covers, stamped on the side and back. It ranks easily as one of the foremost electrical catalogues of the day; in fact there are extremely few productions of the kind anywhere that could be put in comparison with it. The cuts number by the hundred, and are well displayed. All the various and endless specialties and standard goods are carefully grouped, and the fullest information is given in regard to sizes, prices, code words, etc. One admirable feature, indeed, of the whole book is the clearness of the arrangement and the type. The departments represented include all branches of electric light and power work, house electricity, railway work, telegraphy and telephony, and the classes of general supplies and miscellaneous material. The catalogue has been brought down to the latest minute by the insertion of special slips, etc., and constitutes a splendid and complete book of reference on supplies for the whole range of applied electricity.

STANDARD AIR BRAKE COMPANY.

The Standard Air Brake Company has just closed a contract for 60 air brakes for one of the Colonies. In addition to this, they have also closed a further contract for 15 complete air brake outfits, as well as several for some of the Continental cities. While General Manager Wessels, of the Standard Air Brake Company, was abroad, he appointed the following additional agents: Messrs. Dick, Kerr & Co., Ltd., the well known tramway supply people, at 101 Leadenhall street, London, E. C., who will hereafter be the sole agents for the United Kingdom. Also Messrs. E. H. Cadiot & Co., 12 Rue St. Georges, Paris, who have acquired the agency for France. It is expected that a good business will follow these appointments. The Bergsiche Stahl-Industrie, of Berlin, who represent the company on the Continent, have already inaugurated a very good business in air brakes.

SALE OF THE GIBBS ELECTRIC CO.

The Gibbs Electric Company, of Milwaukee, a small concern, some of whose apparatus has been illustrated and described in The Electrical Engineer, has, it is stated, been bought by the Westinghouse Electric Manufacturing Company, for the sum of $50,000.

CUYAHOGA SUPPLY CO.

Mr. F. W. Bunts, formerly assistant secretary and treasurer of the Walker Company, of Cleveland, Ohio, has bought out the Cuyahoga Supply Company, dealers in electric street railway and lighting supplies, and general selling agents for Eugene Munsell & Co. and the Mica Insulator Company in Cleveland and northern Ohio. Mr. Bunts will continue the business under the same title as formerly, occupying the offices at 102 Superior street. Mr. Bunts is a young man who has a large acquaintance in the city of Cleveland and vicinity, and his association with the electrical trade will, no doubt, bring to his company a large business. His leading lines, to which he will devote his special attention, will be the "Micanite" specialties, as manufactured by the Mica Insulator Company, of New York, Chicago and London, and Eugene Munsell & Co.'s India and Amber "Mica" in all of its various forms.

The electrical trade of Cleveland and vicinity will find it to their interest to consult the Cuyahoga Supply Company as to their wants, as a large stock of the above lines will be carried ready for immediate delivery.

THE ENCLOSED ARC LAMP manufactured by the Western Electric Company is meeting with favor among the direct current users of electricity. Features which are commendable are the shape of the globe and the means of support from the top, which prevent any possibility of a shadow caused by the globe. The lamp can burn singly on 110 volts, two in series on 220 volts, or five in series on 500 volts.

MEYSENBURG AND BADT.

This is the style of a new firm recently formed in Chicago, with headquarters at 1522 Monadnock Building. The members are Francis B. Badt, who is well known as one of the foremost electrical engineers in the West; and Mr. E. A. Meysenburg; the former being president of the corporation and the latter secretary and treasurer. The range of their operations will be quite large and will include the work of brokers, contractors and engineers in railway and general electrical equipment, appliances and construction. They will also act as experts in patent causes, and as consulting engineers.

ELECTRICITY IN NEW B. & O. SHOPS.

The erecting and repair shops of the B. & O. at Mt. Clare, in the city of Baltimore, which are the oldest shops in the United States, have been completely modernized. The locomotive-erecting shop has been rebuilt and is supplied with two 50-ton electric cranes, which lift the heaviest locomotives and move them to any point as though they weighed but a ton. The compressed air appliances are of the latest pattern and the cost of making the improvements will be saved in two years, as the new machinery accelerates the work, at a less expense than in times gone by.

ADVERTISERS' HINTS

THE WESTERN ELECTRIC COMPANY, Chicago and New York, advertise their new shadowless enclosed arc lamp adapted to burn singly on 110 volts, two in series on 220 volts and five in series on 500 volts. This lamp was recently described in our columns, and its many points of merit are doubtless remembered.

ARMORITE, the product of the Armorite Interior Conduit Company, Pittsburg, Pa., has been authorized by the New York Fire Department for use in all buildings in the territory under its jurisdiction. The facilities of their new factory are such that any order can be filled promptly.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., set forth a means of increasing dividends by the utilization of exhaust steam for heating purposes.

THE WARREN ELECTRIC AND SPECIALTY COMPANY, Warren, Ohio, have just been awarded the contract for 10,000 incandescent lamps for the new public library in Chicago.

THE PURITAN ELECTRIC COMPANY, Boston and New York, guarantee for the new Puritan alternating enclosed arc lamp 400 watts at 6 amperes and 100 volts.

B. O. ELLIS & CO., 136 Liberty street, New York, the electrical engineers and contractors, are devoting special attention to alternating current work.

HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York, advertise felts for all electrical purposes.

THE ZAMEL ARC LIGHT METER has been approved by the National Fire Underwriters' Association.

NEW YORK NOTES.

MISSISSIPPI FLOODS.—A very interesting little book on this subject, by Mayor W. Starling, of Greenville, Miss., has just been issued by the "Engineering News," St. Paul Building, New York City, at the price of 50 cents. It treats fully and clearly of methods adopted or proposed for the control of these great risings of the river.

OGDENSBURG.—The street lighting contract for one year has been let to the Ogdensburg Power and Light Company, who are in reality the street railway company, at 19¾ cents all night, and every night, 107 lights. The company have water-power six months in the year. The bid of the Ogdensburg Gas and Electric Light Company was 24 cents per 2,000 c. p. lamp, 20 nights per month till 2 a. m., or 25 cents all and every night.

NEWARK, N. J.—The Crescent Electric Company has rented a large building on Market street, and, it is said, will, as soon as the needful machinery can be put in place, start it up in the manufacture of telephones and telephone appliances. The Best Telephone Company, of Baltimore, is said to have licensed the Crescent Company to manufacture machines. It is said 100 men will be employed in the new factory.

JOHNSON & MORTON, Utica, N. Y., are doing a large amount of electrical repairing, with a good staff, the latest machinery and moderate prices.

MAGNOLIA METAL COMPANY have called attention to the newspaper items of recent date relative to the alleged breaking into their factory at Sterling, N. J., and the issuance of a warrant in the same connection. They also request notice of the fact that their relations with H. G. Torrey and J. Gray Torrey were severed on April 15, and that these parties have no connection with their business.

LIVONIA, N. Y.—The Livonia Electric Company is extending its system, and is in the market for apparatus, including a good second-hand automatic 70 to 80 h. p. engine.

BOSSERT ELECTRIC CONSTRUCTION COMPANY, of Utica, N. Y., have their new, large and commodious factory entirely equipped with the newest and most improved machinery and are busy filling orders for their machinery.

YOUNGLOVE & GERE, Syracuse, N. Y., find an increasing demand for their new woven wire brushes.

THE DENNIS FLUOROMETER is being handled by the U. S. Electrical Supply Company, 120 Liberty street. This device has been illustrated and described in The Engineer. It enables, with the use of the X-ray, the exact location of foreign substances within the human organism.

AULTMAN AND TAYLOR MACHINERY COMPANY have issued under the title of "Big Boilers" a spicy pamphlet devoted to the discussion of the relative merits of their own boilers and those of the Babcock & Wilcox Company. The Cahall vertical boiler is also shown.

ONONDAGA DYNAMO CO., Syracuse, N. Y., report several recent installations. Among such plants may be mentioned a 35 k. w. generator direct-connected to a Watertown engine, for a large Sixth avenue, N. Y., retail store; a 35 k. w. generator, direct-connected, placed through Etherington & Co., their Philadelphia agents, and a 30 k. w. plant with Case engine, for the Lackawanna Brewing Co., Scranton, Pa.

J. B. COLT & CO., 115-117 Nassau street, New York, are exclusive agents for the Dolan patent automatic acetylene gas generators, for house and other lighting. The No. 3 generator with one charge of 1,000 pounds of carbide gives an equivalent of 80,000 feet of coal or water gas and will operate 40 to 160 lights. Special smokeless burners are also supplied. The cost is low and there is a big field for this apparatus.

A. L. BOGART COMPANY, 5 East Twentieth street, are successors to the firm of A. L. Bogart and have purchased all the patents, licenses, etc., owned by that well known old house. The present A. L. Bogart, well known in the electrical field, will be treasurer and general manager. W. B. M. Jordan is president, and D. H. Walker is secretary.

EDWARDS & CO. are making a full line of Rhumkorff coils, as high as 16 inches, and are selling large numbers in connection with the X-ray trade. They carry also, it is said, the largest line of different gongs in the country. They report business as rapidly picking up. Catalogue will be sent to any address on application.

NON-POLARIZING DRY BATTERY COMPANY give notice of a special meeting to increase their capital stock to $200,000.

THE PROCTOR-RAYMOND COMPANY, 444 Niagara street, Buffalo, N. Y., manufacturers of electrical specialties, have increased their capital stock and are developing new improvements on their standard articles. Mr. C. M. Proctor is president, Mr. John Gowans, secretary and treasurer, and N. H. Raymond, mechanical and electrical expert.

WESTERN NOTES

BELLS.—The severe competition in the manufacture of electric bells has resulted in lowering the grade as well as the price of the regular electric house bell. Realizing the fact that the trade demanded a better article in the line of an iron box bell, the Electric Appliance Company are placing on the market their Reliance iron box bell, which they claim is considerably better than anything in this line than has been placed on the market for some time. These bells cost more money to make, but are put on the market at an honest price, and to meet the demand of customers who are willing to pay a fair price for a good article.

WESTERN ELECTRIC COMPANY has started very successfully on its philanthropic career as an Art Union. Not long since it issued a fine picture of Niagara Falls, as a great source of power supply. It has now published, as a pictorial commentary on modern trade competition the famous picture, "The Rape of the Sabine Virgins," in which the virgins represent new contracts and the Romans personify the victorious Western Electric salesmen.

AMERICAN RHEOSTAT COMPANY, Milwaukee, Wis., report that business is very good with them, and that they have been running overtime in their factory. They state that their new "Perfection" motor-starting rheostat has met with considerable favor, and the orders for it are coming in fast. Their elevator and pump controllers are also in good demand, and among the orders recently closed by this company was one for 32 crane controllers.

ASHLEY, IND., has made a contract with Mr. H. McIntyre to remove the Garrett Lighting Company's plant to that place. It will furnish 45 arcs and 200 incandescents. The town furnishes ground, puts up the building, gives a contract for 10 lights for five years at $80 per light, with privilege of more lights at $65, and has the right to buy on arbitrated price at any time.

DETROIT, MICH.—The Jenney Electrical Works, lately burnt out at Indianapolis, are likely to move to Detroit, options having already been secured on the plant of the old Detroit Motor Company and another concern.

AUSTIN, NEV.—A fine Westinghouse plant has been installed for the Austin Mining Company by Mr. J. B. Flemming, electrical engineer. It comprises two 56 kilowatt generators, 250 volts direct current. A tunnel over 7,000 feet long with 2,000 feet of cross cut is lit up by 125 220 volt lamps, and about 250 are scattered around the silver mill. The yards are lit up by arc lamps.

ELECTRIC DELIVERY WAGONS IN CHICAGO.—Two electric delivery wagons made their appearance upon the streets here on August 21 and created a mild excitement. They are the property of Stevens Brothers, silk dealers, on State street. Four more will be put in use Monday. They are much like other retail delivery wagons except that they have rubber tires and are more beautifully finished. The vehicles cost $2,200 each, and are run by storage batteries. They can be run at any speed up to sixteen miles an hour, and are easily controlled.

MR. J. S. NOWOTNY, of the Nowotny Electric Company, Cincinnati, Ohio, reports business double what it was a year ago, and inquiries ten times as many.

JOHN A. ROEBLING'S SONS COMPANY has been formed at Chicago, with a capital stock of $5,000, by C. G. Roebling, W. A. Roebling, G. C. Bailey, F. W. Roebling, H. A. Gardner, F. E. Bradley and John W. Beckwith.

LINCOLN, NEB.—Mr. Frank Thomson, on behalf of the Triumph Electric Company, has closed a contract with H. Herpolsheimer & Co., to put a $2,000 plant in their big department store. Mr. Thomson has made several other large contracts in the city.

CLEVELAND, O.—Plans are on foot for the building of a big street railway system in Cleveland in opposition to the Consolidated lines. Most of the capital will be furnished by New York capitalists. Everything has been conducted with the utmost secrecy thus far. Mayor R. E. McKisson is said to be interested in the project.

ARDMORE, I. T.—The Ardmore Electric Light Company has been incorporated under the laws of Missouri with a capital stock of $50,000. C. A. Ross is president, and R. W. Hodge secretary. The plant consists of two Thomson-Houston dynamos of 1,000 lights of 16 candle-power; 100 horse-power John T. Noye engine, Atlas Engine Works boiler of 70 horse-power, and one mile of Phillips Insulated "O. K." wire. The power house is of brick.

NORTHVILLE, MICH., TELEPHONE COMPANY is starting up with a forty drop board, well filled. It has 25 miles of local circuit and 25 miles of toll line. The subscription rate is $1 per month, and the toll line rate is 10 cents. The apparatus is that of the Gilliland Company, of Adrian, Mich. Capital stock is $1,000. J. M. Burgess is president; M. A. Porter, secretary; S. E. Cranson, treasurer.

DAVID CITY, NEB.—W. J. Bell is now running a plant of arcs and incandescents, supplied by one 30-light Thomson-Houston machine and one 500-light General Electric generator. The engine is Sioux City Corliss, and there are about three miles of circuit.

BENTON HARBOR, MICH.—The Twin City Telephone Company was organized June 1, with a capital stock of $20,000, no bonds. W. A. Preston is president; R. Morrill, secretary; John Robinson, treasurer. It has a 400-drop switchboard, 337 subscribers, 400 miles of local circuit, 22 miles of toll line, and charges $16 and $25 per year. The system used is that of the American Electric Telephone Manufacturing Company. Forty-one miles of toll line are now projected.

SIEMENS & HALSKE ELECTRIC COMPANY, of America, are already feeling some of the good effects of approaching prosperity, as they have received quite a number of nice orders recently and are very busy at their large works in Chicago. The prospects of this well known concern doing a large business in the near future are excellent.

MR. THOS. J. AUSTIN, of the Cummings Conduit Company, Detroit, Mich., made a short visit to Chicago a few days ago.

COL. S. G. BOOKER, superintendent of the Phœnix Carbon Mfg. Co., of St. Louis, is a conspicuous example of well directed energy and thought and of ability to adapt one's business readily to the swift changes of industrial and commercial conditions in electricity. He has recently come forward with a vigorous notification of his intention to defend the company's rights in the carbon battery field, under their patents, and having made a specialty of battery carbons he expects very confidently to hold a large battery trade with their standard and popular goods. The Phœnix Company are also actively engaged in the manufacture of many other things in the line of carbons, particularly arc light points and motor brushes. Their plant is well equipped and under Col. Booker's management ever pushes forward into the branches of the art where carbon in any form is likely to be needed.

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Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. SEPTEMBER 16, 1897. No. 489.

ELECTRIC LIGHTING

ARC POLES AND UNDERGROUND ELECTRIC LIGHT CONDUCTORS IN BUFFALO.

FOR some time past the Buffalo General Electric Co. has been carrying out extensive operations in the burying of its overhead circuits and already many miles of duct have been laid.

Camp tile conduits are used throughout, from 12 to 25 ducts being laid with 4 ducts on top layer opening into small distribution manholes 2 feet 6 inches in diameter. The main manholes average about 6 feet 6 inches by 7 feet 6 inches deep, with extra large ones at important junctions with old line of cement lined conduits. The manholes are of the well known double cover type with rubber gaskets and clamp, making a watertight joint. The outer covers are all cast hollow and filled flush with asphalt similar to that used in the streets, with the gratifying result of an entire absence of noise from wagon wheels passing over them. About 2¼ miles of this conduit line was laid on Main street and a connecting line down Court street to the station. A 20-duct line has now been continued down Court street to Niagara street, and thence out Niagara street about 3½ miles to meet the overhead power line from Niagara Falls.

The underground cables are No. 6 B. & S. copper with 3-16 inch rubber and 3-32 inch lead covering guaranteed for 10,000 volts working pressure, and were manufactured by the Safety Insulated Wire & Cable Company, of New York. The cable used in going up the inside of the iron poles has exactly

FIG. 1.—ELECTRIC LIGHT POLE, BUFFALO, N. Y.

the same insulation, but with two layers of jute in place of the lead covering.

The arc lamps are modified Thomson-Rice with special waterproof tops and protecting shield below to meet the globe, as shown in Fig. 1. The lamp hanger illustrated in detail in Fig. 2, is of special design to meet the severe strain imposed by the 6,000 or more volts difference of potential between the lamp and the iron pole, but a few inches separating them. With this hanger the double insulation secured is protected from the weather, the steel bolt terminating in the brass suspension hook being covered with moulded insulatinf material similar to that used in trolley work. This hanger and the porcelain mounted arc switch used in the base of each pole were tested by means of the high potential testing set recently developed by the General Electric Company with a pressure of 11,000 volts before being accepted. Samples of cable were also tested at this pressure and throughout the whole

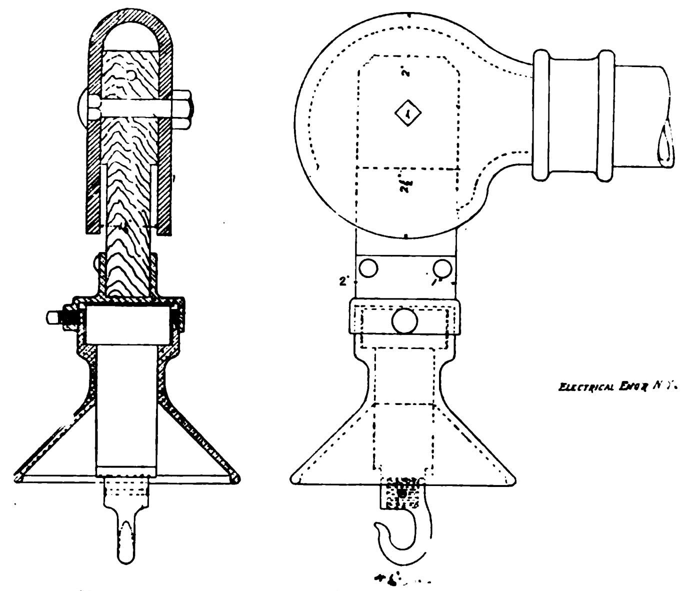


FIG. 2.—ARC LAMP POST SUSPENSION, BUFFALO, N. Y.

system the standard of work has been set at such a point that all material used must stand this pressure.

In pulling in the cables joints were avoided as much as possible by pulling from pole to pole and only making joints in the return cable in the main manholes. This policy of avoiding joints was carried out so well that in 28,000 feet of cable only 35 joints were made. This was made possible by locating a small 2 foot 6 inch manhole opposite each pole, the connection to pole being made by a 2-inch iron pipe with 18-inch radius bend going into the base of the pole.

The dynamos used are the new No. 12 Brush two circuit machines, each armature having thirty-two bobbins and four commutators, capable of giving out 6,250 volts and 9.6 amperes at 500 revolutions per minute. The subdivision of the commutator has already shown itself to be a marked improvement over the former three-commutator type.

ELECTRIC LIGHTING AT HAWLEY, PA.

The Hawley Electric Light and Power Co. is using the power of the Wallen Paupack Falls, a 420 h. p. S. Morgan Smith water wheel driving a 45 k. w. Westinghouse alternator and a 60-light Wood arc machine. There are nine miles of circuit and Fort Wayne converters are used. The officers of the company are W. L. Connell; president; W. K. Edgar, secretary and treasurer, and F. A. Harrington, superintendent. The company are in the market for carbons and 16 and 32 c. p. lamps, 100 volts; and will be glad to receive the catalogues of supply and fixture houses. Mr. Harrington informs us that there is an abundance of power for a manufacturing company, and that he can supply power at cheap rates.

A FEW FACTS FOR "E. E.", EXPERT EXCUSER, OF SOUTH NORWALK.

BY M. J. FRANCISCO.

IN the issue of The Electrical Engineer for September 2, there are nearly two columns of egotistical statements without facts, statistics or proofs of any kind to sustain them except the writer's high sounding title, "A. E. Winchester, E. E."—what a grandiloquent handle he has attached to his name, "E E."—Expert Excuser. Heretofore practical people have claimed that there was no excuse for the fraud, corruption and mismanagement of municipal plants, but here arises an "Expert Excuser" for all such business methods. We have been told repeatedly by this "Expert Excuser" that the results of Municipal Ownership were remarkable, especially in the City of Chicago. A report to the New York "Times" explains some of these remarkable characteristics: "The past week has brought revelations of the most barefaced frauds in the water-works department of the city. A conservative estimate gives $500,000 as the sum of which the city of Chicago has been robbed during the last two years; but in addition to direct stealing there can be no doubt that through lax methods of administering the department the city loses more than $1,000,000 each year, and that is a low estimate. Only very unsophisticated citizens can be surprised at any degree of corruption, no matter how great its magnitude, for the rottenness of the department has long been notorious. The details of the present investigation make manifest the most unabashed fraud and effrontery in the pursuance of criminal methods that indicate long familiarity. So numerous are the methods of defrauding the city that it is a difficult task to keep track of them as they come to light." A short time ago the same conditions were discovered in the fire alarm and electric lighting departments of this city, and proof was abundant that the city had been defrauded out of thousands of dollars; in the mean time, the city electrician, who had the business in charge, was loudly proclaiming (as our "Expert Excuser" is doing) that they were producing lights for one-half the cost of private companies. Here is the practical working of municipal ownership. Is it possible that the "Expert Excuser" is copying Chicago's example and applying it to South Norwalk, and that this is the reason for his squirming when the discrepancies in his reports are exposed? Suppose we reproduce a few of this "Expert Excuser's" figures and statements. On January 7, 1893, this "Expert Excuser" made a report to the mayor, as follows: "The plant has been erected in complete running order and been running since the forepart of October last; the expense attending the running of same ($1,657.46) has been paid from the amount appropriated by the city for the erection of the plant, leaving a balance on hand unexpended of $48.03." Again, in the report made in October, 1893, he repeats the statement that the balance on hand in February, 1893, was $48.03, while on page No. 5 of his report for 1896, he states, "Amount unexpended at starting up of plant was $2,500." In his 1893 report he stated cost of running plant, from time started to that date was $1,657.46—deducting this from the $2,500 would leave a balance on hand of $842.54, instead of $48.03, as he reported in 1893, thus leaving $795.51 unaccounted for, if his 1896 report is true. His 1893 report says they had $1,704.49 of the appropriation left when they started the lights, while in his 1896 report he says (page No. 5) there was $2,500 left when they started the lights. Which one of these reports is false? Did he lie in 1893, or was it in 1896, and what became of the $795.51 which has not been accounted for? Has our "Expert Excuser" adopted the remarkable plan shown by the investigation in Chicago, which he has extolled and admired so often? In his 1893 report to the mayor the following statement is made: "Expense of running the plant from October 13, 1892, to February 28, 1893—wages, $1,040.50;" while in report made October 12, 1893, he says: "Wages paid between October 13, 1892, and February 28, 1893, were $895," thus showing that if this last report is true he had charged the city $145.50 more than was paid for wages. What became of this $145.50; is it à la Chicago again? In his 1893 report this "Expert Excuser" stated that the "average candle-power per lamp was 1,600;" in the October, 1893, report they were given as averaging 1,400 c. p., while in 1896 they were 1,200 c. p. Now, in his last effusion he states that the candle-power "can only be obtained from the record of watts consumed." Thus showing that he knew when he made the statement of 1,600 c. p. in 1893 that it was false and was made for the purpose of casting discredit upon the local company who had previously furnished the lights. His plan was to make it appear that the candle-power under the city management was double that furnished per lamp under the old system by a private company. This "Expert Excuser" has a great deal to say about "honor, distorting facts and misrepresentation." A sample of his criterion of what constitutes honesty, fairness and unbiased comparisons will be seen in the following quotations from his published statement regarding the cost of lights when furnished by a private company and those under the municipal management. "Price paid to the private company for 81 lamps previous to October 13, 1892, was, for 800 c. p. lamp, per night, on moon schedule from dusk until 1 a. m., 22 cents. Cost per lamp, averaging 1,400 c. p. (here he has gone down 200 c. p. below his first statement) per night for year ending October 13, 1893, supplied from the city plant, 90 lamps in use 311 nights per year, no lights on bright moonlight nights, lighting time from dusk to 1:30 a. m., interest on bonds at 4 per cent. and depreciation at 2 per cent., 20½ cents per night." If his statement was true and they paid the private company 22 cents per night for 81 lamps, burned 311 nights in the year, the total cost would be $5,542.02. The city clerk reported to the mayor that in 1892 there was only $4,903.72 in all paid for electric lights and gas, showing clearly that our "Expert Excuser" made the amount $638.30 more than was actually paid the private company. The 81 lights furnished by the city plant burned on the moonlight schedules at price he claims they cost, 20¾ cents per night for 311 nights, would be $5,224.80, or $321.08 more than the same number of lights cost when furnished by the private company. The private company for $4,903.72 which the city clerk reports was paid them, not only furnished the 81 lights from dusk until 1 a. m., but for 7½ months of the year lights were burned every night and all night, thus giving the city about 80,000 hours of service, which this "Expert Excuser" has not shown or credited to the private company in his comparison. Of course, this omission was not intentional on his part, as the high moral character and Christian integrity which this "Expert Excuser" assumes would preclude such methods. Still the comparison was published and used wherever it could be utilized in an argument against a private corporation. The same method was employed when a sewer was built for the electric light plant, costing $414.24. The expense was charged to the sewer account of the city (as shown by the city clerk's report), thus reducing the electric light account that amount. In this "Expert Excuser's" report to the mayor, March 6, 1893, the following statement was made: "Previous lighting of the city cost an average of $12.71 per night for 81 lamps of 800 c. p. each." In his comparison, previously quoted, "Expert Excuser" stated "that cost of lights furnished by the private company was 22 cents per night." Will the "Expert Excuser" explain how he can multiply 81 by 22 and have the product $12.71?

Another plan adopted by this "Expert Excuser" in reducing the cost of lights was when the wire or cable under the river was broken; they repaired it and charged the expense to additions and extensions, instead of repairs, where it belonged. "Expert Excuser" says "that so far as the South Norwalk plant is concerned the author knows nothing of his subject, never having honored it with a visit." This statement is on a par with his others. How could he tell where, when or how the writer spent his time? The author has, however, made three visits to South Norwalk since the plant was established, and has seen that wonderful fireproof station, containing 30 or 40 tons of soft coal, wooden benches, window frames, doors and gallery floor, oil, waste, desks, stairs and partitions—all fireproof, according to his statement; "therefore, no insurance is required." The fireproof soft coal "takes the cake." The author stated that with only 37 per cent. of the heat of coal utilized this "Expert Excuser" claimed the cost of producing the lights was about half that of private corporations who utilized from 60 to 65 per cent. of the heat of the coal. "Expert Excuser," to prove that the author's statement was incorrect, gave the report of the engineer who made the test, as follows: "The largest loss is in the boiler where but 37 per cent. of the heat of coal is utilized. Good average practice for this type of boiler is from 60 to 65 per cent;" thus proving the absolute correctness of my statement by the report of his own expert. It is immaterial what causes the heavy loss in the boiler as long as it exists, but it does show very plainly that "Expert Excuser's" report of cost of lights is not in accordance with the true facts, and that an effort has been made to show a condition of things under municipal ownership which does not exist. The author of this article stated that lawsuits had been entered against the city; "Expert Excuser" says "this is an absolute falsehood." At a hearing before the committee of the Connecticut Legislature, in March, 1897, Judge Stoddard and the Hon. J. B. Alling, of New Haven, Conn., stated to the committee that such suits were in progress and that they were the attorneys for the plaintiffs. One of the suits is against the

city for a direct violation of the laws of its own State, in its efforts to defraud the private company. After the public statement made by these gentlemen to this committee of the Legislature, this "Expert Excuser" has the cheek to state that it is an "absolute falsehood." All of the statements made by this "Expert Excuser" in the vaporing articles he has published are of the same character. Has this man a large vacuum in his head, or is he acting the part of a consummate knave? While the author does not presume to say, the public can judge for itself. "Expert Excuser" also poses as a philanthropist working without pay; still, he was paid $500 for superintending the installation of that little plant of 100 lights, being $5 a light; therefore, if he can induce some other city to adopt the plans he advocates, there will be a chance for him to pocket $500 more, and this may account for his zeal in advocating the system.

Does "Expert Excuser" desire any more of the discrepancies in his reports shown up? If so, I shall be pleased to accommodate him and can furnish a score more of his original mathematical calculations.

TELEPHONY AND TELEGRAPHY

THE ROYSE SYSTEM OF TRAIN TELEGRAPHY.

An ingenious system of train telegraphy has recently been devised by Messrs. C. D. Royse, of Greencastle, and W. A. Royse, of Indianapolis, Ind. This system is an adaptation of the common Morse system of telegraphy for use with only a single sliding connection with the main line. The great obstacle to overcome has been the fact that the continuous electric line necessary for telegraphing could not be broken and carried into a moving train. The Royse system overcomes this by the adoption of the well known principle of split circuits, with the addition of reversed batteries.

In the accompanying diagram, A represents the track of a railroad and B a third rail, which may be simply a small strip of bar iron, weighing not more than three or four pounds to the yard, or even less. This third rail is insulated from the ground, and is the main conductor of the system. Main batteries, M B, are connected in reverse order, that is, both zincs or both coppers are connected to the main line, and the other two like metals to the ground or rails. This would give an electric circuit with no current, on account of the fact that the potential would always be at zero. C is an ordinary telegraph key, which stands open at all times except when in use, and D is a relay of high resistance.

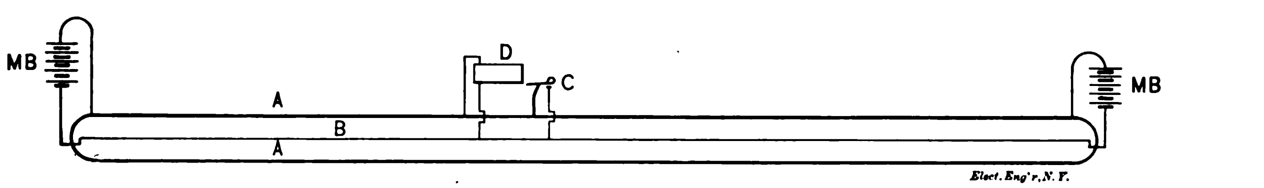
It will be noticed that both C and D have one side connected to the third rail and the other to the track rails or ground. The key is open and therefore gives no connection between the rails and wire, but the relay stands in this shunt or short circuit at all times. This relay is of high resistance, never less than 1,200 to 1,500 ohms, and this is increased as the number of trains on the road is increased.

By tracing from the two batteries to the relay connection with the main line and then through the relay, it will be seen that the effect of placing this relay in connection as it is, is to make two complete circuits, one from each battery to the point of connection, thence to the ground through the common outlet through the relay and its connections. The high resistance of this relay, coupled with the fact that the batteries are reversed and neutralize each other, prevents the grounding of the entire current through this relay. With a resistance of 500 ohms in this relay, or 1,000 ohms in each of two relays, or, in fact, a sufficient resistance in each relay, regardless of the total number to make the net resistance 500 ohms, not more than one-half of the current available in the batteries will be grounded through these relay connections. The current that passes through these relays when the keys are all open, closes them, but by reversing the contact points on the local side of the relays the sounders are made to close when the relays open, so that the sounders stand open when the line is not in use.

The effect of the closing of the key C is to give a direct connection between the main line and the rails without interposed resistance. This establishes a full current from the two batteries to the point of connection with the main line, and as there is no resistance, the entire current is grounded through the key. As the current passes through a number of conductors connected to form split circuits in inverse proportion to the resistance, it is plain that with a net resistance of 500 ohms in the train relays and a resistance of less than 1 ohm through the key circuit, less than 1-500th part of the current will continue to pass through the relays after a key has been closed. This will release the armatures of the relays, and they will open, this action closing the sounders. The relays will close again and the sounders open as soon as the key is opened. This is the main principle of the invention.

Station relays may be connected in the same manner as train relays, or they may be inserted in the main circuit just as the ordinary relay, but all keys must be connected as stated above, and all keys must remain open at all times when not in use. The reason for the latter statement is obvious; the key is not used to open and close the circuit, but is used to ground it.

It is claimed that this system of connections would be an advantage to the ordinary system of telegraphy. All circuit closers would be removed from keys and no operator could leave his office with the line open, as sometimes happens now to the great detriment of the service.



Royse Railway Train Telegraph System.

WESTERN UNION TELEGRAPH EARNINGS.

The Western Union Telegraph Company reports for quarter ended September 30, net revenue, 1897, estimated, $1,750,000; increase, $162,467; interest and sinking funds, $245,000; increase, $1,641; balance, $1,505,000; increase, $160,826; dividends, $1,216,975; increase, $25,014; surplus, $288,025; increase, $135,812; previous surplus, $7,647,541; decrease, $148,366; total surplus, $7,935,566; decrease, $12,554. The present quarterly statement includes the actual figures for quarter ended June 30 last, which completed the company's fiscal year. Actual results of the last two fiscal years, net revenue, 1897, $5,732,202; decrease, $165,778; interest and sinking fund, $975,501; increase, $1,544; balance, $4,756,701; decrease, $167,322; dividends, $4,792,854; increase, $25,049; deficit, $36,153 against a surplus in 1896, of $156,218; increase, $192,371; surplus, $7,603,694; increase, $156,218; total surplus, $7,567,541; decrease, $36,153.

HENRY C. ANDREWS, whose death was noted in the daily papers recently, was an active factor in the exploitation of the Drawbaugh Telephone Company in the days of the sensation caused by that enterprise.

MARYLAND TELEPHONE COMPANY has been formed at Baltimore, with a capital stock of $200,000, by C. Acklen, I. H. Gaither, C. C. Richardson, B. B. Hazlett and C. E. Fink, to make telephones and electrical supplies.

PORTLAND, ME.—Judge Webb, in the United States Court, has given a decision in favor of the Postal Telegraph Company, against the Portland and Yarmouth Electric Line, as to the protection of its circuits in Falmouth from trouble due to the trolleys.

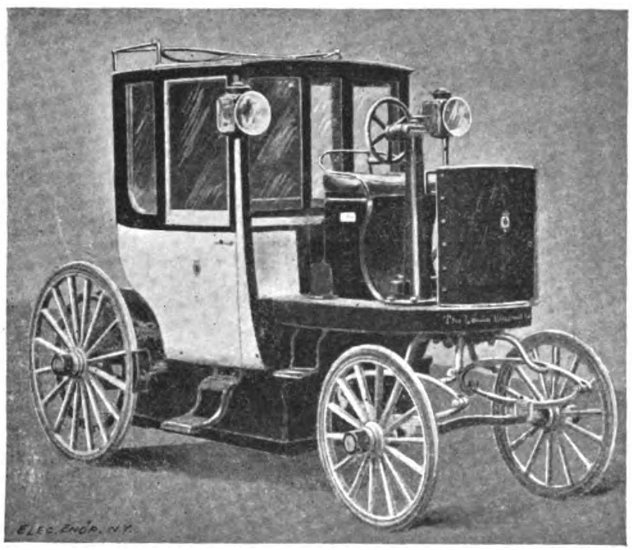
DIXIE TELEPHONE COMPANY has recently been organized with a capital stock of $2,000, with J. H. Northcut, Altamont, Tenn., as president; K. A. Pantolzer, Tracy City, vice-president; W. B. Holt, treasurer; M. Marugg, Tracy City, secretary and treasurer. The plant comprises a Palmer switchboard made by the Utica Fire Alarm Telegraph Company; boxes made by the Mianus, Conn., Electric Company, and Ericsson Swedish coal grain microphones. There are 52 miles of toll line and about 50 local subscribers.

ELECTRIC TRANSPORTATION

LONDON ELECTRIC CABS.[1]

WE had an opportunity this week of inspecting some of the London Electrical Cab Company's vehicles, and we were agreeably surprised with the care and thought which have been expended in their design. If the new company is not too much hampered financially by the agreements made with other concerns at the time of its formation, it would be fairly safe to predict for it a success, as, if electrically-driven autocars are to prosper, the lines followed by Mr. Walter Bersey in the design of these electric cabs would seem to be the right ones.

The battery used on each of the vehicles consists of a set of 40 E. P. S. traction type cells having a capacity of 170 ampere-hours when discharged at a rate of 30 amperes. It is estimated that on the level the current required, when the controller is placed at "full speed," is 24 amperes, and that on a fair incline, at about one-third that speed, this current is not exceeded. Steeper gradients require up to 30 or 35 amperes. The cut-out acts at about 100 amperes, and the driver is provided with a spare one in case of accident. The "afluidic" electrolyte which was to be used is still in its experimental stage. It is intended later to use this, instead of the usual dilute sulphuric acid, in the same type of cells. The E. P. S. Company guarantee the cells for a sum of 10 per cent. per annum of their first prices.



LONDON ELECTRIC CAB DRIVEN BY LUNDELL MOTOR.

The battery is carried in a tray, which is slung under the bottom of the cab by four suspension links supported by springs under compression, and the ordinary carriage springs again separate the cells from the vibration to which the carriage wheels are exposed.

The cabs are placed over a hydraulic table, on to which the tray of cells is wheeled on a light skeleton iron trolley. The table is then raised until the tray comes into the position in which it can be attached to the suspending links. The hydraulic table with the trolley is then lowered, and the cab is left free to propel itself away.

Fig. 1 shows the general external appearance of the cab. But for its color, which is a bright yellow, it resembles a one-horse coupé without the horse. There is only a single seat in the interior, well cushioned and comfortable, and of ample width for 2½ persons.. The tires are of solid rubber, and the running is very comfortable, and silent moreover, only a faint note from the motor being occasionally heard. There is an electric lamp in the interior of the vehicle, and the outside lamps are also electric. The steering is effected by the two front wheels, through ordinary worm gearing turned by a handle on the driver's right hand in the usual manner.

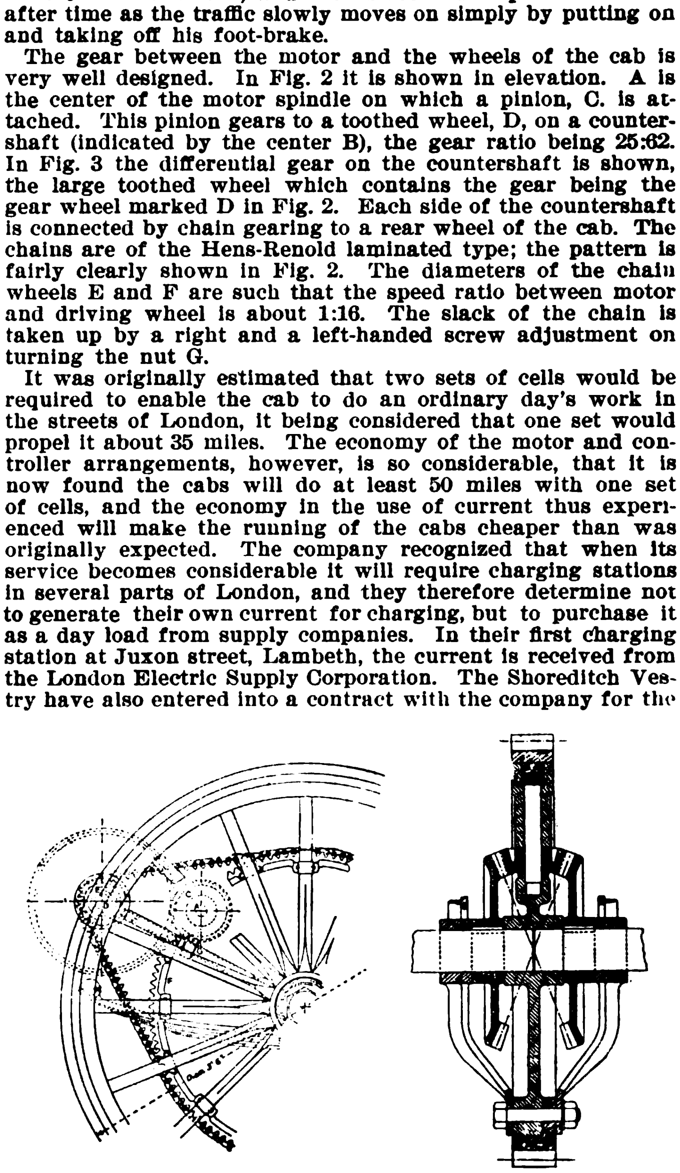
[1]London Electrician.

The motors have been specially designed for these cabs. They are of the Johnson-Lundell type, and supplied from America. The fields have two similar windings, and the armatures have also two similar sets of windings and two commutators. This doubly-wound motor is connected to a series-parallel controller of the usual American pattern in exactly the same way as the two motors of a tramcar would be connected to it.

The whole of the controller movements are produced by the use of one lever placed at the left-hand side of the driver's box. The removal of a plug beneath the driver's seat disconnects the controller from the motor and cells. The circuit from the accumulators to the controller and motor passes through a switch attached to a foot-brake, which can also be used for bringing the cab to a stop. This switch is arranged to break the circuit when the foot-brake is applied. It is therefore impossible for a careless driver to apply the brake whilst the current is still passing through the motor. The foot-brake has another advantage in the crowded London streets, for when moving in a block the driver can set his controller handle to slow ahead, and then start and stop the cab time after time as the traffic slowly moves on simply by putting on and taking off his foot-brake.

The gear between the motor and the wheels of the cab is very well designed. In Fig. 2 it is shown in elevation. A is the center of the motor spindle on which a pinion, C. is attached. This pinion gears to a toothed wheel, D, on a countershaft (indicated by the center B), the gear ratio being 25:62. In Fig. 3 the differential gear on the countershaft is shown, the large toothed wheel which contains the gear being the gear wheel marked D in Fig. 2. Each side of the countershaft is connected by chain gearing to a rear wheel of the cab. The chains are of the Hens-Renold laminated type; the pattern is fairly clearly shown in Fig. 2. The diameters of the chain wheels E and F are such that the speed ratio between motor and driving wheel is about 1:16. The slack of the chain is taken up by a right and a left-handed screw adjustment on turning the nut G.

It was originally estimated that two sets of cells would be required to enable the cab to do an ordinary day's work in the streets of London, it being considered that one set would propel it about 35 miles. The economy of the motor and controller arrangements, however, is so considerable, that it is now found the cabs will do at least 50 miles with one set of cells, and the economy in the use of current thus experienced will make the running of the cabs cheaper than was originally expected. The company recognized that when its service becomes considerable it will require charging stations in several parts of London, and they therefore determine not to generate their own current for charging, but to purchase it as a day load from supply companies. In their first charging station at Juxon street, Lambeth, the current is received from the London Electric Supply Corporation. The Shoreditch Vestry have also entered into a contract with the company for the supply of current at its second charging station, at the price of 1½d. per kilowatt hour.



FIGS. 2 AND 3.—DRIVING GEAR OF LONDON ELECTRIC CAB.

The cabs are to be fitted with integrating ammeters, arranged so that the driver can see by a glance at the dial what proportion of the charge of the cells he has already used.

FALLSBURGH, N. Y.—The Fallsburgh & Monticello Railroad Co. expect to extend eleven miles to Neversink Flats and Grahamsville. They have six miles of track, four cars and one motor car for freight; with two 200 h. p. boilers in their power

house and two 150 h. p. engines. The offices of the president, Mr. B. Van Steenburgh, are at 53 Broadway. The company has a capital stock of $75,000.

THE DE BAUSSET AIR-SHIP.

FOR a number of years past Dr. A. De Bausset, of Brooklyn, has been working at the problem of providing an airship which should be capable of carrying an appreciable load and be completely dirigible at the same time. Dr. De bausset purposes to construct of steel a cylinder 774 feet long and 144 feet in diameter. This would hold, roughly estimated, 10,000,000 cubic feet of air. A cubic foot of air weighs 0.08+ of a pound. By pumping out the air and creating a vacuum, 400 tons of weight would be disposed of. In other words, the displacement of the airship would be 400 tons.

The airship, built of material strong enough to withstand the enormous pressure from the outside, due to the vacuum within, would weigh 250 tons.

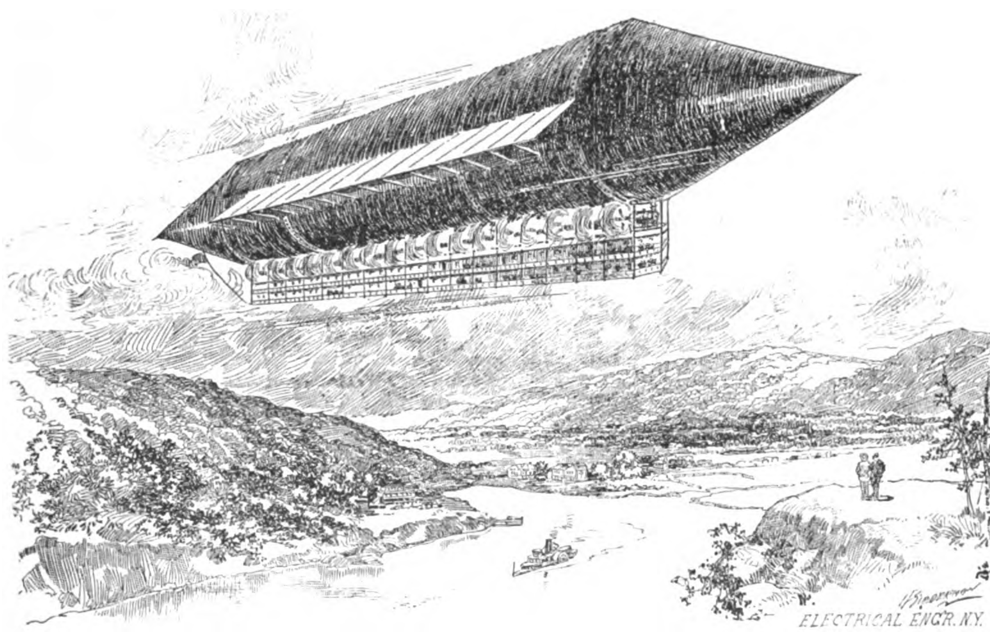
The following data give the principal dimensions and weights:

Length of cylinder, cone-shaped at both ends, feet..	774
Diameter, feet	144
Displacement, volume, cubic feet	10,000,000
Displacement, weight, tons	400
Weight of steel for cylinder and cones, tons	215
Weight of car beneath, tons	35
Weight of electrical appliances, machinery, etc., tons	33.4
Weight of air remaining within cylinder as ballast, tons	66.6

The air pumped out equals 333.4 tons, leaving an external pressure of 12.25 pounds per square inch. The total weight of materials, machinery and air in reserve is 350 tons, which, deducted from the capacity of the cylinder, 400 tons, leaves an ascensional lifting power of 50 tons.

The partial vacuum will allow an amount of 66.6 tons of air in reserve to counteract atmospheric pressure of 2.4 pounds per square inch of area. Part of this ballast will be pumped out in the common reservoir if an extra load is to be carried, or for any emergency.

Suspended from the cylinder, as shown in the accompanying engraving, is a car, which will carry the engines, dynamos, electric motors, propellers, etc. The airship will be steered by changing the angle of the propellers, which will be pivoted with that end in view.



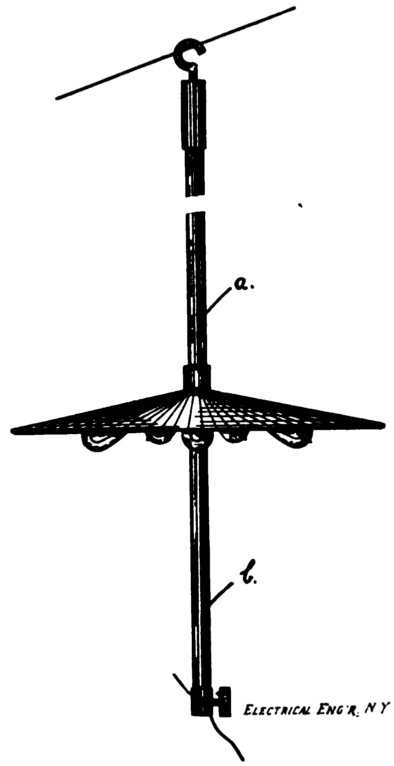
THE DEBAUSSET DIRIGIBLE ELECTRIC AIR SHIP.

All details, such as motive power, etc., have been carefully estimated. A Congressional committee, after looking into the plans, thought so well of them that it recommended the appropriation of $150,000 (House bill 5,717) to construct a ship. The bill, however, was pigeon-holed in the Senate Committee on Naval Affairs.

HANDY ELECTROLIER FOR TROLLEY TRACK NIGHT REPAIRS.

BY N. M. HOPKINS.

THE accompanying little sketch shows an arrangement of lamps in combination with a pole and reflector, well adapted for track lighting during night repairs or alterations.



ELECTROLIER FOR RAILWAY REPAIRS AT NIGHT.

The illustration is self-explanatory; the wire a b is connected to five 110 volt lamps in series for a 550 volt street railway service. The connection with the rail is made by a clamp, or in any other suitable manner by means of a flexible cable. The device is in use in Boston, the only city thus equipped which has been noticed by the writer.

PITTSBURG, PA.—Col. A. H. Swan, of Ogden, Utah, F. L. Pushaw, of Boston, and others are to organize a local plant, it is said, to cost $100,000, for the manufacture of a new electric traction brake upon which they control the patent.

THE PRESENT TENDENCIES OF ELECTRIC TRAMWAY TRACTION.[1]

BY J. G. W. ALDRIDGE, A. M. INST. C. E.

TRAMWAY work is at the present time, and has been for some years past, characterized by an increasing use of mechanical traction systems. The reasons for this are obvious and self-evident. It is, however, worth while to look into the considerations that, so far as electric traction is concerned, have caused one system or another to grow into favor, noting also the inherent qualities or attributes of each, which must have an effect on future developments.

The United Kingdom has practically 130 miles of electric tramway at work or under construction; of this length 103½ miles are operated on the trolley or overhead wire system, 15¾ miles by means of a third rail conductor, 6 miles by means of storage batteries, and only 4 miles on the underground conduit system. These proportions may be taken as fairly representative of other countries also, as far as can be ascertained.

They seem likely to be maintained or even increased in favor of the overhead wire system, unless radical improvements can be made in the direction of a cheaply built and maintained conduit method, or more durable and light accumulators for placing direct upon the car. Objections to the overhead trolley wire system are almost entirely æsthetic, but at the same time have such great weight and force that every incentive is offered to the genius of invention to make improvements in other directions.

The ordinary underground conduit with open slot is most expensive to instal and troublesome to maintain efficiently; it cannot be built for less than 10,000l. or 12,000l. per mile. Even its latest form (consisting practically of an underground trolley wire) must require an outlay of nearly double the cost of an overhead wire system.

Closed conduits with surface contacts usually operated by means of electromagnetic switching devices in boxes under the street level are complicated, and it is to be feared are unreliable. The great weight of lead required on each car for accumulator traction means practically that the live paying load can never reach 25 per cent. of the gross weight of loaded car; whilst the combinations of trolley wire and battery, attempted on systems like those of Hanover and Dresden, are obviously ill-designed, the dead weight of battery being carried throughout the entire journey, though it is not required for part thereof.

The overhead trolley wire system therefore appears likely to come into still greater use than has already been the case, if only on the ground of economy; but in view of its admitted defects, the author has worked out an alternative method which avoids the erection of trolley wires along the streets above the tracks.

POWER REQUIRED OF DRIVING VEHICLES.

SOME interesting tests have recently been undertaken in France with regard to the power required for the propulsion of vehicles, fitted with wheels with ordinary iron rims and pneumatic-tired wheels, and the results showed a marked all-round advantage by the pneumatic wheels. A table of the pull required, reduced to kilogrammes, shows the results with different roads and different loads:

	Iron. Rims. Kilog.	Pneumatic. Tires. Kilog.
Snow.		
Empty vehicle, walking	17.86	11.45
Empty vehicle, trotting	29.60	15.27
150-kilogramme load, walking	17.83	12.71
150-kilogramme load, trotting	31.17	17.96
Wet Roads.		
Empty vehicle, walking	16.00	10.50
Empty vehicle, trotting	19.55	12.97
150-kilogramme load, walking	17.30	12.43
150-kilogramme load, trotting	23.00	14.16
New and Dusty Roads.		
Empty vehicle, walking	17.42	14.05
Empty vehicle, trotting	20.41	15.95
300-kilogramme load, walking	20.75	19.14
300 kilogramme load, trotting	29.70	16.40

Experiments were also made with various pressures in the tires—3 and 4½ atmospheres—but there did not seem to be much difference between the two.

[1]Read before the British Assoc. at Toronto.

AUTHORIZED SPEEDS OF TROLLEY CARS.

The rates of speed for street railway cars as established by the ordinances and franchises in different cities are as follows in and out of city limits: Albany 12 miles per hour, Binghamton 12 miles, Brooklyn 6, 8 and 10 miles, Buffalo 12, 15, 18 and 30 miles, Elmira 7 and 15 miles, Rochester 6 and 12 miles, Allegheny, Pa., 15 miles, Omaha 10 and 15 miles, Grand Rapids 7 and 15 miles, Washington 6, 12 and 15 miles, Boston 7, 10 and 12 miles, Denver 9 and 15 miles, Des Moines 8 and 12 miles, Columbus, O., 8 and 14 miles, Dayton, O., 10 miles, Evansville, Ind., 12 miles, Kansas City 12 miles, Louisville 10 and 12 miles, New Haven, Conn., 10 and 12 miles, Paterson, N. J., 10 and 15 miles, Providence, R. I., 9, 10 and 12 miles, Rochester 7 and 15 miles, St. Louis 10 and 12 miles.

SOME FURTHER EXPERIMENTS ON THE X-RAY.[1]

BY T. C. PORTER.

MESSRS. A. VOSMAER and F. L. ORTT have arrived at the conclusion that the X-rays are more or less perfectly discharged particles.[2] Others—Sir W. Crookes, for example—have suggested the material nature of the rays, and the only novel point in the paper referred to seems to me to be that the rays owe their greater or less penetrative power to the fact that they are particles less or more free from electric charges. If this were the case, it seems scarcely possible that the particles could pass as freely through, and in the neighborhood of, a conductor when charged as when uncharged. If the particles were completely without charge, it is true they should be equally affected by a conductor first charged positively, and then with an equal negative charge. On the other hand, if the particles were positively charged, they would experience stronger attraction to a conductor negatively electrified than to the same conductor equally positively charged; and the same, mutatis mutandis, may be said if they are negatively charged.

The effect one might expect is that the uncharged particles would at first be attracted by a charged conductor, and then repelled from it, if they acquired part of its charge, in which case the photographic image of the uncharged conductor produced by the X-rays would be modified in intensity if not in form[3]—probably in both.

If, as Messrs. Vosmaer and Ortt suppose, the "rays" are dis-electrified by striking against the charged anode inside the tube, it is difficult to see why they should not be re-charged, and therefore act like other charged particles, if they strike against an electrified conductor outside the tube, especially if the potential of the external conductor be as great or greater than the potential of the internal. Indeed, the authors of the paper admit this; and if it is true, one might reasonably expect some such action as I have sought for.

I therefore thought it would be, at any rate, worth trying experiments to see if the X-ray photograph of a conductor, such as of a small plate of aluminum (with carefully rounded edges), differs according to (1) whether it be charged or not, and (2) whether it be charged positively or negatively.

According to the paper the X-ray particles are to be considered free from charge when they completely discharge a charged insulated plate, without afterward imparting to it a charge, and the focus tube I used in all these experiments was one which gave rays of this description.

In the first set of experiments two small squares (A and B) with rounded edges, cut from the same piece of sheet aluminum, and one-thirtieth of an inch in thickness, were arranged in the same horizontal plane beneath the focus tube placed symmetrically with respect to the anode of the tube, so that the line joining the centers of the squares was in a direction at right angles to the line joining the center of the anode and the center of the cathode mirror. Below these small squares, and resting on a thick block of paraffin, was placed the photographic plate (all the plates used belonged to the same batch)—

[1]London Nature. [2]See Elec. Engr., Sept. 9.

[3]The alteration in form, and to a certain extent intensity, would depend partly on the velocity with which the particles were traveling. I do not remember reading of any determinations of the velocity of propagation of the X-rays; but if this remains very high over great distances, as it seems to do, it would appear very unlikely that the rays consist of material particles.

the Ilford special rapid, and all the plates of each set of experiments were developed together in the same dish). The tube was worked by a large coil, giving six-inch sparks, and A and B were electrified when necessary by wires from the poles of a Wimshurst machine with leydens giving seven-inch sparks between the knobs when used in the ordinary way. The duration of each exposure was timed by a stop-watch in each case, and was as nearly as possible the same for each set of experiments.

A blank experiment in each set, in which the plate, wrapped in dark paper (the same number of folds in every case), was exposed to the radiation from A and B without the Röntgen rays, proved that no photographic effect was produced by their electrification by the Wimshurst.

Exposures were then made as follows: (1) A and B both earthed by a wire soldered to a gas-pipe. (2) A positively, B negatively electrified. (3) A negatively, B positively electrified. (4) A positively, B to earth. (5) A negatively, B to earth. (6) A and B both earthed.

Development showed that the electrification of A and B was without effect, either absolute or comparative.

Since in the above experiments sparks passed between A and B when their difference of potential exceeded an amount far less than that which could be given by the Wimshurst, and it seemed possible that a stronger charge might still yield some indication of a difference, one of the aluminum squares was removed, and the other shifted till it was immediately beneath the anode, and a second set of experiments was made in a rather different way. In each pair of exposures the same plate was used, each half of the plate being protected, whilst the other half was exposed by a thick slab of plate glass—proved by experiment to allow no developable action of the X-rays to pass through it during the time of exposure used. The experiments were as follows:

(1) A blank experiment without the X-rays in which one-half of the plate was exposed, first to A charged positively to the full power of the Wimshurst, and then the other half to A charged negatively in the same way. The result showed there was no developable action. (2) 1st half X-rays only, then an interval of rest (the same interval being allowed between every experiment), then the 2d half to the X-rays only; this was done to see how the emission of the tube varied. (3) 1st half A positively charged, 2d half X-rays only; A to earth. (4) 1st A negatively; 2d A to earth. (5) 1st A positively; 2d A negatively. (6) 1st A insulated; 2d A to earth. (7) Same as (2). (8) Same as (1).

The whole of this series was repeated, using the contents of one box of Edwards's isochromatic plates. Development showed no action which could be attributed to the electrification of A.

In the third series of experiments A was connected by a wire first to the katnode loop and then to the anode loop of the focus tube, and radiographs were taken comparing the effects of this treatment with that of earthing A; but these, too, gave no indication of any increase or decrease of the X-rays reaching the plate, nor of any re-distribution of the rays.

In the fourth set the photographic plate was placed on an ordinary discharging table, and brush discharges, and afterward thick sparks were passed between the poles of the discharger, and the radiographs developed; but they showed no traces whatever of any effect of the sparks.

I, therefore, conclude that the radiograph of a conductor (though it is true I have only tried aluminum and brass) is not sensibly altered by even powerful electrification, nor are the rays altered in force or direction in passing through air in the neighborhood of a powerfully-charged conductor, nor even through air which is being subjected to a powerful disruptive discharge.

This seems to me to make it more difficult to believe that the X-rays are due to particles, whether totally or partly devoid of charges of positive or negative electricity.

LITERATURE

THE ELEMENTS OF ELECTRO-CHEMISTRY, TREATED EXPERIMENTALLY. By Dr. Robert Luepke. Translated by M. M. Pattison Muir, M. A.. Philadelphia, 1897. J. B. Lippincott Company. 223 pp.; 8½ x 5½ in. 54 illus. Cloth.

This translation of the second edition of the popular handbook of Dr. Luepke, gives a complete review of electro-chemistry, together with descriptions of the more important electro-chemical processes and problems. In its present state this book serves both as a guide for the student as well as a ready reference for the expert.

LETTERS TO THE EDITOR

TEST OF THE THOMSON RECORDING WATTMETER.

THERE appears in a paper by Mr. Ricks, read before the British Association at Toronto, a description of certain tests made in my laboratory on various electric supply meters. From the results there given it would appear that the Elihu Thomson energy meter (or so-called "recording wattmeter") when used at ordinary temperatures reads about 13 per cent. too low at one-tenth full load, and that, when measuring ordinary direct current loads, an increase of temperature of 30 degs. C raises the speed of the meter by about 11 per cent.

I have no reason to doubt the accuracy of Mr. Ricks' results, indeed the very careful and painstaking way in which he carried out the investigation described in his paper leads me to think it highly probable that the figures and curves which he publishes do really record the behavior of the meters which he tested. But, during my recent visits to the works of the General Electric Company, at Schenectady, and at Lynn, I have become convinced that the particular meter which was lent Mr. Ricks by the British Thomson-Houston Company for testing can not be regarded as a sample of the instruments which are now being manufactured in large numbers.

From his tests of the Thomson meter Mr. Ricks states, "It may, therefore, be surmised that the coefficient" (of change of resistance with temperature) "of the pressure coil is very much less than that of the copper disc." To construct an energy meter with this difference in the temperature coefficients is, of course, quite wrong scientifically, and Professor Elihu Thomson tells me that in his instructions he has emphasized the fact that the temperature coefficient of the pressure circuit should be equal to that of the copper pressure disc. As a proof that this condition is really fulfilled in the Thomson meters constructed in the States various curves have been shown me, from which it appears that, at ordinary loads, a change of 40 degs. C in the temperature of the meter alters the constant only 3½ per cent., instead of by the 11 per cent. found by Mr. Ricks.

Further, I have watched tests being made on one of these meters at Lynn at temperatures of 60 degs. C, and at 24 degs. C. The meter in question was a 50 volt 15 ampere meter, and, when tested at 52 volts and 11.75 amperes, that is, at about three-quarters of full load, there was only 1 per cent. difference between the results obtained at these two temperatures although they differed by 41 degs.

Next, as regards the difference between the value of the constant of this type of meter at low and high loads it would appear from the curves which have been shown me recording the results of various tests, that with some specimens there is practically no appreciable difference in the value of the constant anywhere between full load and one-twentieth full load, while with other specimens the constant is about 2 per cent. higher at one-tenth of full load than at full load. These are very different results than those obtained by Mr. Ricks with the meter lent him for testing, for he found that the constant at full load had to be increased by 19 per cent. to make the meter read correctly at one-twentieth of full load.

Some hurried tests at various loads were made in my presence here, of the meter already referred to. The results at low loads were not very satisfactory, as the meter armature turns very slowly, of course, at small loads; and time pressed, as the factory was on the point of being closed for three days. Hence we had to content ourselves with timing one revolution only of the armature instead of waiting to take many, as was done in the very much more accurate tests carried out by Mr. Ricks. But it seemed clear that the variation of the constant between full and one-thirtieth of full load was not as large as was found by Mr. Ricks between full and one-twentieth of full load.

Hence, I conclude, both from the curves of previous tests, as well as from the tests which I saw carried out, that the Elihu Thomson meter tested by Mr. Ricks had not merely a much higher temperature coefficient than meters constructed at Lynn, but possessed a greater frictional resistance, or had "an initial energy coil" which was not powerful enough.

Lynn, Mass. W. E. AYRTON.

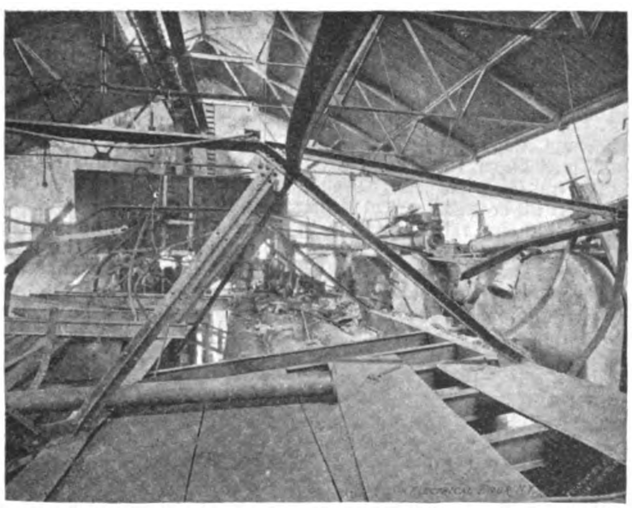
MECHANICAL

A TEST OF THE ABILITY OF BOILERS TO STAND OVERLOAD.

BY FREDERICK A. SCHEFFLER, M. E.

IT has been interesting to note the record in a recent issue of The Electrical Engineer of the curious and unusual accident in the Edison station at Paterson, N. J., the promptitude with which it was met, and the conditions of test and strain that it threw upon the apparatus. Mention has been made of some of the circumstances and results, but there are others to which I believe engineers will also be glad to have their attention directed, bearing as they do upon some of the most vital and essential details of central station work.

The Paterson boiler room, it will be remembered, is equipped with a battery of six 450 h. p. Stirling water tube safety boilers, in the rear of which is located an economizer furnished by the Fuel Economizer Co. Over the firing room was placed a large coal storage bin, built of sheet steel and channel beams and angle iron; the whole bin being sustained by riveted columns extending from the bottom of the coal bin to the floor, the upper part of the coal bin being much wider than the base of same projected over the top of the boilers. At the time of the accident this coal bin contained in the neighborhood of 1,000 tons of buckwheat coal, and it extended from one end of the boiler room to the other. The coal was apparently equally distributed throughout the bin. The coal was delivered to the bin by a complete coal conveying apparatus, furnished by the Hunt Company. Each boiler was furnished with a main steam outlet 10 inches in diameter, the pipe connections being extra heavy wrought iron. The outlets from each boiler ran to a 12-inch main steam header immediately over the top of the smoke connections, this pipe extending the full length of the boiler room. The accident consisted in, first, the giving way of part of that side of the coal bin not adjoining the boilers, permitting a large quantity of coal to be precipitated on the floor of the boiler room, entirely filling up the pump pit, in which fell at least 50 tons of the coal, and eventually this whole side parted. This threw the unbalanced weight on the opposite side of the coal bin nearest the boilers, thus causing this entire side of the coal bin, together with about 400 tons of coal, to be thrown forcibly on top of the boilers and steam connections. At least 100 tons of steel girders, plates, angle irons, etc., besides the coal, was precipitated on top of the boilers. There were but two of the boilers in operation at the time and an additional one had the fire banked ready for being put in service for the evening load; the pressure of 155 pounds was being carried on the boilers, steam mains, etc.



VIEW OF BOILER ROOM, PATERSON, N. J., EDISON STATION, AFTER COLLAPSE OF COAL STORAGE BINS.

A fair idea of the damage which occurred to the steam main can be obtained by referring to the accompanying cut, which shows only part of the iron work on top of the boilers, as all of the coal and a large proportion of the framework was removed at the time photographs were taken. It will be seen that the steam main was entirely demolished, and so great was the force of the fall that part of this heavy piping was smashed in as though it had been made of paper. When the side of the coal bin fell the force was so great that when it struck the safety valves the latter pierced the one-quarter-inch plate, presenting the appearance of projectiles in the plates.

It is remarkable that the only injury sustained by the boilers consisted of bending some of the short tubes connecting the upper parts of the steam drums and making slight depressions around the steam outlet of the nozzles of the four boilers.

The general popular impression immediately at the time of the accident was that the boilers had exploded, for the reason that so great was the force and quantity of the steam which was liberated when the steam pipe connections broke, it was difficult to form an adequate conclusion as to just what had happened. The boiler house became full of steam and it was impossible for several minutes to permit even a casual examination to ascertain just what the accident was. Developments soon proved, however, that the entire battery of boilers were intact and that nothing had occurred to them except as above outlined.

No description can give even an approximate idea as to what it means to distribute 1,000 tons of coal in such a hurried manner. It was nothing short of an avalanche. The boilers were buried from the floor up to a height of at least 10 feet in the coal. Fortunately the four men who happened to be in the building at the time the accident occurred managed to escape without any injury. Much credit is due to the general manager, Mr. Brock, and the chief engineer, Mr. Merrill, in having taken such prompt and positive action in the matter of removing the coal so that within a few hours the boilers were made accessible. The natural result of having the steam pipes destroyed, of course, was the shutting down of the entire plant. Within 28 hours after the accident occurred, steam pipes were temporarily arranged so that one of the boilers could be operated, and this boiler was operated from midnight of the 16th inst. until the following morning, carrying pressure steam to about 750 i. h. p., and for the following 15 hours the same boiler supplied steam to three of the Ball & Wood engines, developing from 1,400 to 1,800 i. h. p. As the boiler has a nominal rating of 450 h. p. and the engines are compound condensing, it will be seen that the boiler was operated at least 113 per cent. above its rated capacity at the regular pressure of 150 pounds! Forced draught was utilized to produce the extreme overload. Notwithstanding the high percentage of overload, no trouble whatever was experienced on account of water being carried over with the steam, and no better test has ever been made to demonstrate the fact that the "Stirling" boilers furnish dry steam irrespective of the duty they are called upon to develop.

This performance of the boiler following immediately after the enormous strain brought upon it on account of the amount of coal and ironwork, without previously having made any water test to determine whether the boiler was injured in any manner, demonstrates the fact that the construction of the Stirling boiler is more than could be asked by the most exacting engineers. It also demonstrates the fact that all wrought steel in the construction of boilers can be relied upon under the most exasperating conditions, whereas, if any of the parts under pressure or in the supports had been of cast iron there would have been a weak element in the construction which would have a tendency to have produced the complete demolition of the boilers. Only the best of material was used in the bricking up of the boilers, and although they were entirely supported independent of the brickwork by wrought steel columns and girders, it should be remarked that the results of the accident show that first-class work pays in the end, as none of the brick walls were in any manner whatsoever injured.

ELECTRIC CARS TO THE GRAND CANYON, COLORADO.

Lombard, Goode & Co., of Chicago, are the backers of a railway from Flagstaff to Williams, Ariz., or to the crest of the Grand Canyon of the Colorado.

Just now tourists have to ride 100 miles by stage to see this wonderful and majestic sight. The company now controls several miles of right of way along the southern rim of the canyon, which will be used in the building of an electric scenic road for sightseeing purposes.

The several waterfalls will furnish 30,000 horse-power, allowing for liberal loss in transmission.

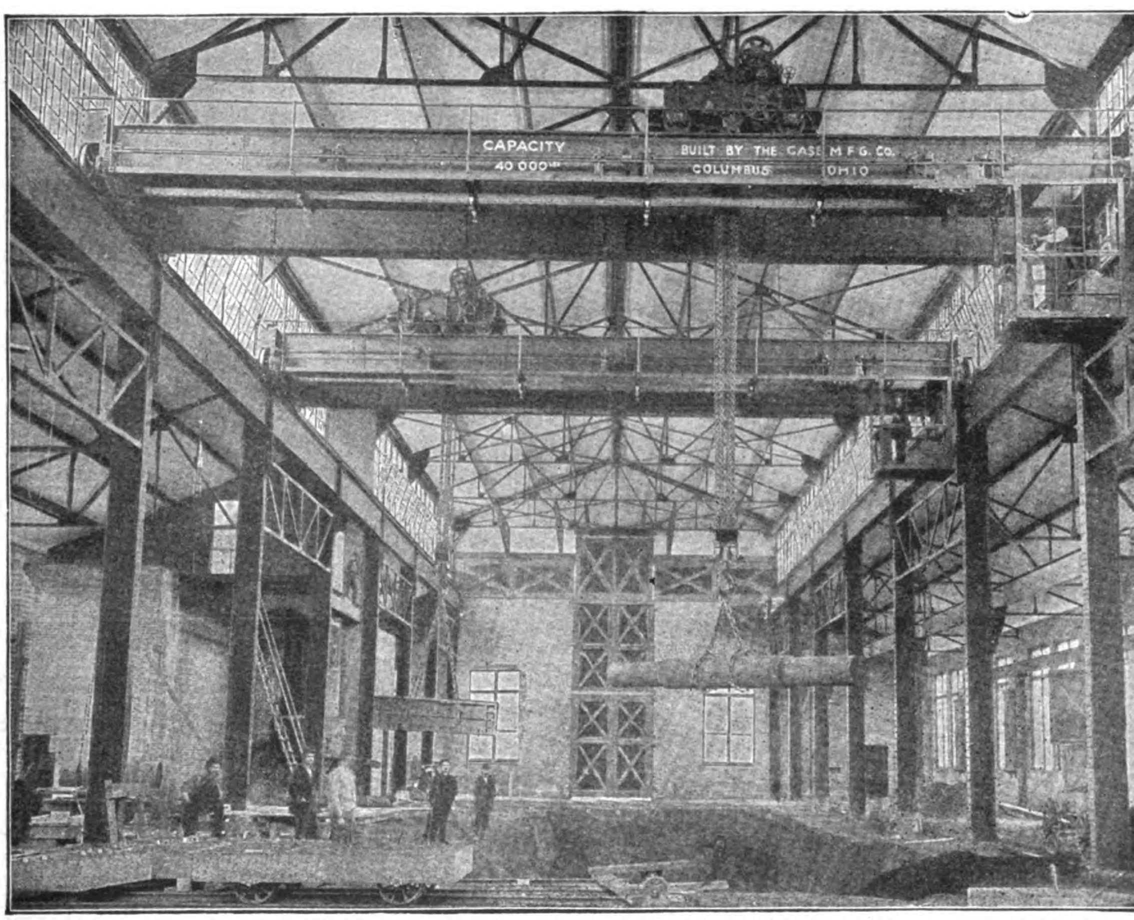
POWER TRANSMISSION

CASE THREE MOTOR ELECTRIC CRANE.

The accompanying illustration shows two modern three-motor electric cranes of 40,000 pounds capacity each, which have just been placed in operation in the C. & G. Cooper Co.'s foundry at Mt. Vernon, O. Among the special points of merit is the construction of the bridge in which the girders and end plates are riveted together securing the desired strength with great rigidity and freedom from vibration which is so destructive. The arrangement of the bridge wheels is such that they can be removed and the boxes replaced by simply raising the crane off the gudgeons, thus making all the working parts most accessible. The bridge motor is located near the operator's cage, thus exposing it to the least heat from the different departments of the foundry and so arranged that the motor as a whole or in part can be detached without disturbing any other parts of the machinery. The hoisting gear of the hoisting trolley is of the double drum type, the chain winding from each end, thus distributing the load equally on the hoisting drums and the bridge girders.

The trolleys are built with the Thompson automatic retaining hoisting gear, a newly patented device which requires no brake, to prevent the load from backing down. The lifting load provides its own braking power. Thus the ability to hold increases as the load increases, and the control is made absolute and independent of any brake or electrical current. This will be recognized as a great advantage in both efficiency and safety. The hoisting and trolley motors are so located on the trolley that either can be easily removed or detached without derangement of other parts of the machinery. The gearing is all machine cut and the bearings are either babbitted or fitted with bronze bearings. This equipment is found to be best adapted to the work which it has to do and to permit of its being renewed with but little trouble. The motors used are of the best modern design and an inspection of the cranes conveys the idea of efficiency and durability.

These cranes were built and erected by the Case Manufacturing Company, of Columbus, Ohio.



Electric Cranes—Case Manufacturing Co.

NEWS AND NOTES

DISCUSSING A PACIFIC CABLE.

A special dispatch from Vancouver, B. C., of September 7, says: The following named telegraph men held a closed meeting in Vancouver in connection with the proposed cable line from Vancouver to Australia: George G. Ward, vice-president and general manager of the Commercial Cable Company; S. S. Dickenson, superintendent of the company at Canso, where the Canadian Pacific line connects with the Atlantic cable; R. V. Dey, secretary to President John W. Mackay; J. Wilson, Pacific Coast superintendent of the Canadian Pacific telegraphs; L. W. Storrer, superintendent of the Pacific Postal Telegraph Company. After the meeting no news of a direct nature could be obtained regarding the business transacted, but statements were freely made that inside information obtained warranted the announcement that a Canadian Pacific cable from Vancouver to Australia would be an assured fact at a comparatively early date and that the present meeting had to do with some very important preliminary arrangements in which Mr. Mackay is to take a very prominent part.

Mr. Storrer stated that his company would, of course, handle the Pacific cable work at this end, and that he, with others, would inspect the proposed landing stages in British Columbia at once. The entire party will leave for Victoria to-morrow.

THE

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ENGLISH AND AMERICAN ELECTRIC RAILWAY DIVERGENCIES.

IT is most gratifying to note the increasing interest taken in electric railroading in England, made apparent by the gradual though steady addition to the number of such roads in operation. In respect to the number of electric roads, England is far behind some of its continental neighbors, though as regards date of installation its roads were well among the earliest. But now that England is waking up to its opportunities there is arising the question of its sources of supply for railway material of all kinds, and recent developments seem to foreshadow a change in the present condition of affairs. Having so rapidly and fully developed the art it was but natural that this country should be drawn on for much of the material used on English railways in the past. But that America can hardly hope for the bulk of the English electric railway trade in the future is strikingly shown by a recent example. Some years ago, when the short line connecting Leeds with Roundhay was constructed, American manufacturers supplied the engines, dynamos, motors, cars, trolley wire, switchboards, trucks and gearing—in fact, everything but the boilers and the rails. In the new Leeds tramways just opened to traffic, however, we note that the only supplies of American make are the trolley wire, trucks and part of the gearing. There is nothing surprising in this; on the contrary, it is a wonder that it took such a long time to come about. It would be strange, indeed, if English manufacturers should have confessed themselves unequal to meet the demands of a new industry, and to let outsiders carry off the trade without an effort to prevent it. It is plain, therefore, that if American manufacturers want to retain their hold, even partially, on the English market, they must keep in advance and compel trade by offering a superior article.

In line with this change of base for electric railway supplies is the recent refusal of the Liverpool Town Council to sanction the appointment of an American as consulting engineer for the proposed city electric railways. The gentleman in question, whose name need not be mentioned, has had an experience, perhaps, second to none, in electric railway construction in all its branches. One of our London contemporaries in applauding this resolve of the Liverpool authorities considers it both politic and patriotic not to encourage those beyond the English borders to a greater extent than those within. Our contemporary is willing to give us all the honor and credit due for having built up the electric traction industry, but it does not follow, it asserts, that American methods—constructional, commercial or consultative—are suitable to English requirements, and, if not, why place such touching faith in Transatlantic men and methods? It goes on to say that it is not to be supposed for one moment that English electrical and tramway engineers have during the past seven years failed to "mark, learn, and inwardly digest" all that American experience can teach them—and more to the same effect. And yet we venture to say that an experienced American electric railway engineer would be found a paying "investment" by the Liverpool or any other English municipality or company undertaking to install an extended system of electric railways. Three thousand miles is a long distance from which to "mark learn and inwardly digest" an entirely new art. American electrical journals and books and the papers contributed to American electrical societies may, no doubt, have done much to keep foreigners au courant with what we have been doing, but without desiring in the least to belittle the efforts or value of the American electrical press, we submit that what gives the engineer his greatest value is experience. If this were not so every college graduate who has the rules and formulæ of his profession at his fingers' ends would be the superior of many an engineer of twenty years' standing who has long since forgotten his calculus and the theory of functions. The point here at issue is not one of knowledge but of experience. We grant that many wideawake English engineers may have an excellent knowledge of electric railway work, as evidenced by several admirable English works on the subject, but the experience for which engineers are consulted and paid can only be gained by actual practice. If this view be correct it would certainly be advisable to consult American electric railway engineers. The differing conditions between American and English practice, which constitute the staple of our contemporary's argument, do not appear to us to be so great as to weigh at all heavily against the American engineer on English soil. Besides, we imagine, that in some respects we do things better here, and that even the conservative Britisher could be brought about to adopt some American methods—"constructional, commercial and consultative," to his advantage.

ELECTROLYTIC ACTION IN CONDENSERS.

AS condensers are likely to be used more and more in connection with alternate current work, it is of importance to recognize the action of electrolysis, which may have an appreciable influence on their performance. This is well brought out in the excellent paper read by Dr. Guthe before the A. A. A. S. at Detroit. Besides the other disturbances that this action may bring about in condensers, Dr. Guthe points out that the heating observed in condensers is due probably in large part to the Joule effect, rather than to dielectric hysteresis. The moral of this is that too much care cannot be exercised in the elimination of all moisture from condensers intended for alternate current work—a point which has already been recognized by some manufacturers.

PATENT LAW REFORMS.

IT will be generally conceded that some of the Statutes relating to patents in the United States might be amended to advantage and that some of the methods in vogue in the United States Patent Office might be changed with benefit to the patentees of the country. We doubt, however, whether the condition of affairs is such as to call for such radical changes as are suggested in a series of questions submitted to the National Association of Manufacturers. Among these questions the first relates to the advisability of the Government charging an annuity on patents, trade-marks, copyrights, etc., in order to invalidate such patents as are not considered by the owners of sufficient value to warrant the annuity, but which, nevertheless, stand a menace to new and useful patents for fear of infringement. A very large proportion of the patents in force, it is argued, are of little or no value to the owners, and are not being made use of, but are often found to contain some element making it necessary to procure their control in order to avoid possible litigation or infringement by patents of later date, the merits of which make it desirable for them to work, both for the owner and public. The cold-blooded assurance of the proposers of this scheme is worthy of admiration, but results of the change are plainly evident. The proposition as it stands amounts to nothing less than a confiscation of the rights of a patentee who may be either too poor to work his invention or who, for any other reason, may be incapable of carrying it out in practice. We do not, for a moment, doubt that some manufacturers would like to see many existing patents wiped out, but there is neither justice nor equity in such a proceeding. We are not oblivious to the fact that such an annuity system as that proposed is in vogue in most European countries, but the system has never recommended itself here, and many an American inventor has had good reason to deplore its existence. If it be a question of revenue for the Government to maintain the Patent Office, it need only be pointed out that the United States Patent Office is its only self-sustaining department, and at the present moment shows a balance to the good of nearly $5,000,000 extracted from the inventors of the country since the foundation of the patent system. The suggestion that foreign inventors should be compelled to pay an annuity in conformity with the practice in their respective native countries also seems inexpedient, and, if carried out, would probably lead to reprisals on the part of those foreign governments, to the detriment of American inventors. Recent action of this very nature following the passage of the Dingley Tariff bill ought to be a sufficient warning on this score. We are heartily in favor of the suggestion, however, of separate courts of adjudication of patents to expedite litigation, though the recent constitution of the Circuit Courts of Appeals has done much to mitigate the evils of the past. One can understand that many grangers should feel embittered toward the patent system, after having had to pay royalty on their driven wells, but why manufacturers who have been so greatly benefited by the patent system should do aught to curtail its value is beyond our comprehension. It is true that a patent constitutes, and is intended to constitute, a monopoly, but far from being one "in restraint of trade," it has in almost every instance been a stimulator and creator of trade which never existed before. The abuses which have arisen out of the patent system in the past, and we do not pretend to say that such have not existed, are due largely to inherent defects in the Statutes and Patent Office practice; these are gradually being eliminated, and in time will cease to exist. By all means, let the patent system alone; it has suffered enough from its enemies, without being still further harassed by its friends.

A USELESS STRUGGLE.

WE believe that very little opposition was encountered by the old horse railroad companies, on the part of their car drivers when electric traction was introduced, and that the men themselves hailed the change with delight as relieving them of a good deal of labor and the worry of keeping a pair of brutes up to schedule time. Reasoning by analogy, therefore, one would imagine that the cab drivers would view with similar approval the introduction of electric cabs, but, if we are to judge by recent events in London, such is not the case. In fact, at a meeting of the executive committee of the London Cab Trade Council, in which the question of electric cabs came up for discussion recently, a resolution was read expressing disapproval of the introduction of electric cabs on the streets of London, and urging all cab drivers, in the interest of the cab industry, to discourage any further development of public vehicles driven by motive power. The position in which the London Cab Trade places itself is evidently little short of ludicrous. To imagine for one moment that the tide of progress can be stemmed by any such resolution is the height of short-sighted folly. If electric, or any other automobile, cabs can be operated more cheaply, and with greater comfort to the riding public, they will be adopted, and their increasing number seems to point strongly in this direction. The horse has practically been banished from the car track, and it may not be long before it will be driven from the street entirely. The thing for London cab drivers to do is to join in the march of progress, rather than to enter into a struggle, the outcome of which can only be defeat for them.

X-RAYS AS A CURE FOR BLINDNESS.

THE subtle properties of the X-rays very soon after their discovery suggested their employment as a medium for enabling the blind to see. So far as we are aware, however, no tangible results were obtained, although numerous experimenters worked in this direction. The suggestion that the X-rays themselves might be used as a cure for blindness rather than as a medium for distinguishing objects is a remarkable one, yet if we are to believe reports, a case of this kind is recorded from Havana, where a physician claims to have partially restored the sight of a blind man by means of the application of the X-rays. Considering that the patient had previously been given up as a hopeless case, this new development may well create surprise. While we have every confidence in the good faith of the gentleman through whom the facts have reached the public, it would be the part of prudence to await more complete details before accepting the facts as fully demonstrated, and thus giving rise to hopes which may not be realized.

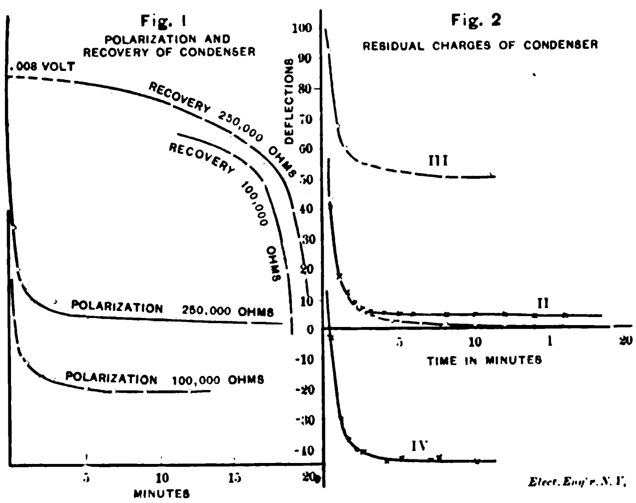
MISCELLANEOUS

ELECTROLYTIC ACTION AND INSULATION RESISTANCE OF A COMMERCIAL CONDENSER.[1]

BY DR. K. E. GUTHE, UNIV. OF MICHIGAN.

THE insulation resistance of a cable or of an absorbing condenser is a function of the time during which an external e. m. f. is applied. The apparent resistance increases very rapidly at first and then approaches slowly a maximum value. The methods usually employed for determining the insulation resistance are the direct deflection method or those in which the cable is charged, then allowed to leak, and after a given time discharged or recharged. We measure the amount of charge which goes into the condenser and base the calculation on the supposition that it also goes through the dielectric. As the absorption becomes smaller, the resistance is apparently increasing, the effect of the soaking in of the charge becomes less and less and finally only the quantity of electricity which leaks through remains. The question arises whether the large change of resistance is only due to the absorbed charge. To decide this we have to find a way for separating the two components.

Among the condensers in our laboratory we found one of a capacity of 10 microfarads, subdivided into units, which showed unmistakable signs of electrolytic action probably due to traces of acid in the paraffin used as the dielectric. The



FIGS. 1 AND 2.

condenser had previously been subjected to a voltage of 20 volts and had been afterward short circuited for several days. On opening the circuit and discharging the condenser at equal intervals through a ballistic galvanometer, we obtained appreciable deflections, which increased with the time to a maximum. After this was reached the deflection remained constant, no matter how long the time-intervals (from 15 seconds to 5 minutes) between consecutive discharges were taken. Apparently the discharge was not due to an absorbed charge leaking out, but the condenser acted like a cell which has been short circuited and recovers on the opening of the circuit.

Since under these conditions the condenser is nothing else than a high-resistance battery, we can employ for finding its resistance a method which is independent of an external e. m. f. The simplest way is to measure the e. m. f. (E_1) and the difference of potential (E') when the circuit is closed through a known external resistance R; then

$$r = \frac{E - E'}{E'} R.$$

To measure E', the cell has to be closed for a very short time only. The closing and opening of the circuit was done automatically by means of a pendulum apparatus, so that no appreciable polarization could take place.

The resistance of the condenser had been determined before by direct deflection and was found to be more than 250,000 ohms for one hour, after the external e. m. f. of 70 volts had been applied. It had become fairly constant, but was still increasing slightly.

The method outlined above gave us an entirely different result, since the resistance was found to be a great deal smaller than expected. We charged and discharged a Stanley condenser of 3 microfarads with the e. m. f. (d) and the P. D. (d') when the external resistance was R. The resistance calculated is given under r.

R	d	d'	r
12,500 ohms.	70	42	8,300 ohms.
25,000 ohms.	70	52	8,600 ohms.

If the circuit is closed only a very short time, the resistance of the condenser is only about 1-30 of the resistance found by the direct deflection method.

A number of experiments were undertaken to show the rapidity with which the condenser polarizes and recovers. The curves correspond closely to the curves taken with ordinary cells. They are quite steep at the beginning of the polarization, but show also a fair recovery. In Fig. 1 the results are plotted. Curve I. was taken with an external resistance of 250,000 ohms; Curve II. with one of 100,000 ohms.

In order to determine the residual charges in such a condenser it is apparently necessary to balance first the e. m. f. of the condenser and then apply the external potential difference. The results are plotted in Fig. 2. In Curve I. the e. m. f. was in the same direction in which the e. m. f. of the condenser would act; in II. the two are opposed to each other. Both curves coincide at first. After a short time both run parallel to the X-axis, and we found by changing the interval of time from 30 seconds to 1 and 2 minutes, that the remaining constant deflections are due to polarization in one case, in the other due to an increase of the e. m. f. of the cell, and not due to residual charge. The charge absorbed is independent of the direction of the applied e. m. f. (in our case 3.4 volts for .2 second). Curves III. and IV. show the results when no balancing cell (about .02 volt) is inserted in the circuit.

After this we tried to reverse the direction of the e. m. f. of the condenser. The combined 10 microfarads had an e. m. f. of .008 volt. We first put 3.8 volts on all 10 microfarads for 30 minutes, then on only 5 microfarads for 2 days. After that the whole condenser was short circuited for some time and then the potential differences of the subdivisions redetermined. The application for 30 minutes had not been sufficient to reverse the e. m. f., but the divisions subjected to the impressed 3.8 volts for 2 days showed the desired effect, some quite strongly. The different units showed great differences in the value of the e. m. f., and it was decided to use in the following one of the reversed units, which showed a large e. m. f. (.0305 volt) and a small resistance.

Now, we undertook to determine how the surprising difference in the resistance of the dielectric depends on the time during which the circuit is closed. Experiments made with alternating currents show in general that the resistance of a dielectric works out to be larger, the slower the rate of vibration, and indeed this variation being a great deal larger than could be expected from the theory. A striking example has been published by Eisler (Ztsch. f. Electrotechn., June 15, 1895). The resistance of a 2.5 m. f. condenser varied from 64,800 to 22,100 ohms when the frequency of vibration was varied from 17.9 to 45.1. Hand in hand with this goes the experience that the specific inductive capacity varies similarly. But Threlfall (Phys. Rev., July, 1897) showed that after continuous and careful drying the effect is greatly reduced.

The only observation of a dependence of dielectric resistance upon the time during which a constant current is flowing through it, has been made by Hertz (Wied. Ann. 20, p. 279, 1883), who investigated the conductivity of benzene. Commercial benzene showed a very large increase of resistance with the time. He showed, moreover, that what he calls the residual charge, is due to some kind of polarization, and not to absorbed electricity.

In our experiments we discharged the condenser, one microfarad, through different external resistances, and measured the throw of a ballistic galvanometer. Then we made the auxiliary e. m. f., which was found to balance the e. m. f. of the condenser, send a current during the same time through the galvanometer.

In the experiments the time was varied from a very small fraction of a second to about .2 second, which is the longest time we could safely take, without polarizing the condenser.

The general results deduced from these observations are:
1. The dielectric resistance of a condenser, in which we find

[1] Abstract of a paper read before the A. A. A. S. at Detroit, August, 1897.

electrolytic action[1], increases with the time during which a current flows through it.

2. The time being constant, the resistance seems to be the smaller, the larger the current.

It seems therefore clear that, especially with alternating currents, the greatest care has to be exercised in the selection of a propr condenser. The higher the frequency the greater will be the loss of energy due to the small resistance of the condenser. This is to be considered in addition to whatever may be lost by real absorption. I believe, moreover, that the heat produced in condensers when subjected to an alternating difference of potential is mostly due to Joule's effect and not to hysteresis.

The second point becomes clear only when the circuit is closed for a comparatively long time, the influence of the errors of observation being too large in the other cases. Polarization, if present, would make the differences less pronounced.

These results gain in importance from a theoretical point of view, if we compare them with those obtained with batteries. Uppenborn, Carhart, Greeff and others have observed a decrease of the resistance of batteries with increasing current, and this effect is more pronounced in dry batteries than in liquid cells. Apparently this variation depends to a great extent upon the solvent in which the electrolyte is contained. Moreover, I have found, pursuing the investigation on ordinary cells a little farther, that a variation of the time during which the circuit is closed, gives us different absolute values for the resistances. Greeff, as well as I, could not obtain the same results for the curves by first increasing the current and then decreasing, or vice versa. The second set always gives a curve for the resistance which lies above the first, the resistance having increased by the use of the cell. Greeff found, moreover, when he measured the resistance of cells with an alternating current, that the same form of curve resulted, but that the values of the resistances were always smaller than when he employed a steady current. This explanation, namely, the formation of acid, I was able to disprove by chemical analysis.

Corresponding experiments with electrolytic resistances seem to confirm our results. Various alternating current methods were compared with a constant current method recently proposed by Stroud and Henderson, who employ two high-resistance vessels in two arms of a Wheatstone bridge and eliminate the error due to possible difference of polarization by employing a high voltage. The values of the resistance obtained by the last method is always a little larger, about 1 per cent., than the corresponding values obtained by Kohlrausch's method. We could also verify Wien's observations that the resistance appears to be the larger the lower the frequency of the alternating current.

In most of the experiments I was assisted by Mr. G. F. Fisher, and I wish to express my obligations to him for the valuable help he has rendered me.

FLUE GAS ANALYSIS IN BOILER TESTS[2]

BY PROF. D. S. JACOBUS.

THE paper, which the author intends to publish in full in the Transactions of the American Society of Mechanical Engineers, will contain a comparison of the results obtained by means of the Elliott gas analysis apparatus for the composition of gas with the composition as determined by mixing together known volumes of the elementary gases. In addition to this, the errors involved by the absorption of the gases in the water used in the apparatus and in the solutions will be discussed.

Experiments already made have shown that a large error may arise in measuring the initial volume of the gas on account of the absorptive power of the water for carbonic acid gas. To eliminate this error, we pass a considerable volume of gas through the measuring tube, allowing it to bubble up through the water in the bottle which forms part of the apparatus. This causes the water which clings to the sides of the glass measuring tube to become saturated with gas, so that there is no absorption before recording the initial volume; whereas, if the tube is simply filled with gas without forcing an excess of gas through it, there may be a considerable amount of carbonic acid gas absorbed before the initial reading is obtained.

To obtain an average sample of the gas over any desired interval of time we use collecting bottles, as shown in Fig. 1. The bottle, A, is completely filled with water, and the bottle, B, is filled to just above the point at which the rubber tube, b b b, is connected. Gas is drawn into the bottle, A, through the tube, a a a, leading to the flue, or chimney. When gas is drawn into the bottle, A, the bottle, B, is lowered, as shown in the sketch. The rate of flow of gas into the bottle, A, is regulated by adjusting the glass cock, D. After filling A the cock, C, is closed, and the bottle, B, raised and placed on a shelf some height above A. The gas, which is then under pressure, is then led through a rubber tube connected to the cock, E, to the Elliott apparatus.

The bottle, B, is lowered about 5 feet below the bottle, A, in order to cause the amount of suction, and, consequently, the rate of flow of water from the bottle, A, to vary only between small limits. If desired, the bottle, B, can be lowered as the bottle, A, is being filled with gas, in order to obtain a more uniform flow of water from A than would exist with the bottle, B, stationary.

The flow through D varies as the square root of the head; hence, a slight difference in the head of water will not cause a great variation in the rate of flow.

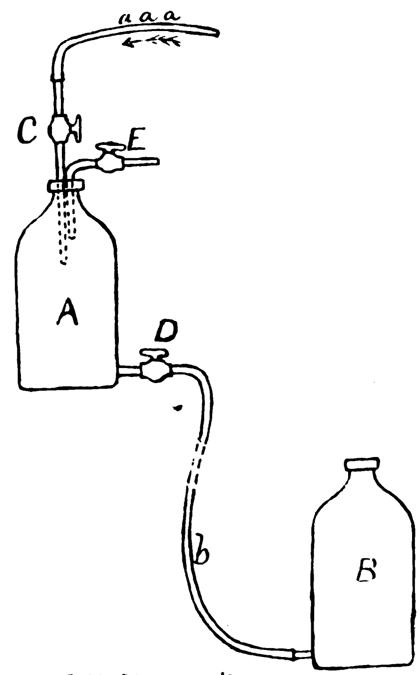


FIG. 1.

To allow for the absorption of gas in the collecting bottles, we draw the bottle, A, about one-half full of gas a number of times before starting the tests, and shake the water it contains thoroughly, so as to cause it to become saturated with the gas.

Experiments have been made by adding salt to the water to decrease the absorptive power, and it is proposed to try other liquids than water. The results of all these experiments will be given in full in the paper.

ARC SPECTRA.[1]

BY PROF. ARTHUR L. FOLEY, INDIANA UNIVERSITY.

THE image of a normal electric arc appears to consist of three regions; a central violet portion, an outer yellow sheath or flame, and an intermediate sheath of blue. By means of a Rowland grating and Brashear mounting, and a concave mirror to focus the image of the arc upon the slit, a photographic study was made of the spectra of these regions under four conditions: (1) a vertical arc and slit, (2) a vertical arc blown out by a magnet, (3) a horizontal arc and slit, (4) a horizontal arc and vertical slit. A table gives some results with a vertical arc and a vertical slit through the center of each region. The table extends from $\lambda = 3092$ to $\lambda = 5015$. The whole number of lines visible was 1,994, of which 1,842 were measured and 1,787 identified.

[1]Almost all commercial paraffin condensers, which show strong absorption, show also traces of electrolytic action. The two seem to be intimately connected. In condensers in which great care has been taken to exclude moisture and air, for instance, in the Stanley condensers, no electrolytic action can be found, but also the absorption is extremely small, as compared with the former.

[2]Abstract of a paper read before the Amer. Assoc. Adv. Sci., at Detroit.

[1]Abstract of a paper read before the A. A. A. S. at Detroit, August, 1892.

The table shows that the lines rapidly decrease in number as the slit is moved from the center of the arc to the outer edge. This is due chiefly to the fading out of the carbon bands, only a few of the stronger carbon (or cyanogen) heads being visible in the outer sheath. But the fading out is not confined to the carbon as the lines of all the other elements of the table show the same tendency, though to a much smaller degree.

The lines of the table were not only measured and identified, but their intensity was estimated at three points; at the upper end near the positive carbon, at the center, and at the lower end near the negative carbon. The calcium and iron lines were relatively much stronger in the outer regions than the lines of any other element. All the lines of any one element did not fade out at the same rate. But it does not appear that there are any lines which have a maximum of intensity in the outer sheaths. Neglecting for the present the thickening of the lines at the poles and considering each region of the arc as a whole, it may be concluded that the differences observed in the spectra are due chiefly, if not entirely, to temperature differences.

The spectra of twelve elements were studied to determine the nature of the lines near the carbons and directly between them. The spectrum was obtained by removing the core of one or both of the carbons and replacing it by the salt of the metal to be studied. The salts used were barium carbonate, sodium nitrate, the chlorides of zinc, calcium, strontium, potassium and lithium, the sulphates of chromium, cadmium and aluminum, and the oxides of rubidium and titanium.

Photographs were taken with both direct and reversed current; when the salt was in the upper carbon only, when in the lower carbon only, and when in both carbons. In every case the carbon lines clung to the positive pole and the metallic lines to the negative pole. When the upper carbon contained calcium and was made positive, all the calcium lines extended across to the lower negative pole. But when the current was reversed, of the forty-seven lines which appeared at the upper negative pole, only fourteen extended across to the lower positive carbon. The latter were due to calcium contained as an impurity in the lower carbon, for they were not stronger than in the ordinary arc.

The following experiment is more conclusive:

The negative carbon of a horizontal arc was filled with calcium chloride. A new plain carbon formed the positive pole. The carbons were placed 1 cm. apart and an arc was formed by passing between them a third carbon which served to bring the poles into momentary contact. After one minute the current was shut off and the carbon containing the calcium was replaced by a new plain carbon. The arc was then formed by means of a third carbon, and the spectrum was photographed. No calcium lines appeared except those always present in the ordinary arc.

In the second part of the experiment a plain carbon was used as a negative pole and the calcium was placed in the positive pole. The arc was formed as before and allowed to continue for one minute. The positive pole containing the calcium was then replaced by a new plain carbon, the arc was formed and the spectrum photographed. The calcium lines came out very clear and strong, almost as strong as if the negative carbon had been filled with the salt. There can be but one conclusion. In the first case the calcium was in the negative pole and there was no tendency for it to pass across to the positive pole. In the second case it was placed in the positive pole and it freely passed over to the plain negative pole. The latter became so impregnated with it that it was capable of giving a strong spectrum of calcium when it was afterward used in an arc with a plain carbon.

The electrolytic nature of the arc was further confirmed by a series of measurements of the voltage necessary to maintain an arc of given length between unlike electrodes. It was found that a higher voltage was required when the salt was placed in the negative pole than was necessaray when the salt was in the positive pole. When one of the carbons was replaced by a metal rod, a higher voltage was required when the current was flowing from the carbon to the metal than when it was flowing in the opposite direction. The details of this portion of the work will be given in a subsequent paper.

As far as could be determined, the order of the elements, as regards the tendency of their spectral lines to cling to the negative pole, is the same as their order in the electro-positive-negative series.

A study was made of the spectrum of the enclosed arc with a lamp manufactured by the Helois Electric Company. The lamp was modified so that the lower carbon, which was hollow, extended outside the globe.

When the spectrum was photographed immediately after starting the arc, it was identical with the spectrum of the open arc. After a minute or two the arc shortened and the metallic lines began to disappear, soon disappearing almost entirely. The carbon and cyanogen bands were stronger than at first.

It appears that a comparatively rapid disintegration of the carbon poles is necessary to supply enough material in the arc to bring out clearly the metallic lines which are due to very small quantities of the metals contained in the carbons as impurities. The rapidity of the disintegration depends upon the quantity of oxygen present in the globe. After the oxygen had become exhausted by allowing the arc to burn a few minutes, the wasting away of the poles was very slow indeed. When carbondioxide was introduced into the arc through the hollow lower carbon the wasting of the poles increased and the metallic lines reappeared. Air still further increased the wasting of the poles and the brilliancy of the metallic spectra. When pure oxygen was passed into the arc the poles were rapidly consumed. The metallic spectrum was very bright, likewise the carbon and cyanogen bands.

In the enclosed arc, as in the open arc, there was the same general tendency for the metallic lines to thicken at the negative pole, and the carbon lines to cling to the positive carbon.

A UNIVERSAL ALTERNATOR FOR LABORATORY PURPOSES.[1]

BY PROFESSOR HENRY S. CARHART.

THE design of the machine to be described was adopted for the following reasons: 1. Simplicity of construction by students in the engineering shops without special tools or dies. 2. Its similarity to a bi-polar dynamo so as to illustrate one, two or three-phase current generation but without a low limit to the frequency. 3. To illustrate practically the effect of combining e. m. f.'s differing in phase, in a variety of ways.

To accomplish these objects both the field and the armature were made with poles, the latter having two more than the former. The field revolves and is of the C. E. L. Brown type. The armature is made of sheet iron rings held together by bolts between cast iron plates. The spaces between the poles of the armature were milled out after the rings had been bolted together. The field is made of two identically similar steel castings, each with five poles symmetrically spaced and pointing in the same direction parallel to the axis. The field has thus ten poles, alternating in sign, and the armature twelve. The following are some of the dimensions:

Diameter of armature pole faces	10.25 in.
Length of faces parallel to shaft	1.5 in.
Width of pole faces	1.5 in.
Pitch of poles on armature	2.68 in.
Depth of poles	0.5 in.
Net cross section of pole in sq. in.	5.4 in.

The armature poles were wound with forty turns of No. 16 wire. The double air gap is 0.25 in. The field coil contains 1,012 turns of No. 16 double cotton covered wire.

The armature coils were wound in reverse order from pole to pole in the usual way. They are connected in pairs and the terminals of each pair are brought up to binding posts on a board on top of the machine.

Diametrically opposite poles of the field are of opposite sign, while the corresponding coils of the armature are similarly wound. Hence with a closed coil armature, the e. m. f.'s balance exactly as with a bi-polar dynamo. If therefore connection be made with the armature at two opposite points, the current in the external connecting circuit will be alternating. Further, two such circuits connected at right angles will convey currents in quadrature. By connecting at points 120 degrees apart, three-phase currents will be obtained.

Again the coils may be joined either in mesh or star fashion by means of the binding posts, and we may zig-zag across either with two or three-phase connections, so as to connect opposite coils by twos or threes with no phase difference between the two opposite groups. This connection of course gives the highest e. m. f.

It is evident that the phase difference from coil to coil is 30 degrees, or one-twelfth of a period. Hence the voltage for a given magnetic flux cut per second, calculated in the usual way, must be first multiplied by two to reduce from maximum to virtual volts, and then the equal e. m. f.'s generated by the several coils must be added geometrically with a phase difference of 30 degrees from coil to coil. Since the e. m. f.'s of the several coils are equal and differ in phase by a twelfth of a period, the series may be represented by a regular polygon of twelve sides. Hence if E be the e. m. f. of one coil, the following will be the e. m. f.'s of the several groups of coils:

E. m. f. of two coils, $2\ E \cos 15^\circ = 1.93\ E$.

E. m. f. of three coils, $E + 2\ E \cos 30^\circ = 2.73\ E$.

[1] Read before the American Assoc. for the Adv. of Science, Detroit.

E. m. f. of four coils, 2 E (cos 15° + cos 45°) = 3.346 E.

E. m. f. of five coils, E + 2 E (cos 60° † cos 30°) = 3.73 E.

E. m. f. of six coils, 4 E cos 15° = 3.86 E.

It will be seen that the phase difference between the coils reduces the e. m. f. of the six in series on either side to 3.86-6, or 0.643 of what it would be were there no such phase difference.

It will be seen from the subjoined table that the observed e. m. f.'s agree every closely with those computed from the foregoing equations.

	Observed.	Computed.
One coil	21	20.5
Two coils	40.3	39.6
Three coils	55.5	56
Four coils	69	68.6
Five coils	75.5	76.5
Six coils	77.5	79.1

With about 2,000 ampere turns on the field coil, the following observed voltages were obtained for the several connections described in the first column. The computed values are readily obtained from the preceding expressions:

Connection.	Observed.	Computed.
Two-phase mesh	79	79
Two-phase star	112	112
Three-phase mesh	69	68.6
Three-phase star	121	118.8
Three-phase zig-zag	136	136.8

The alternator was driven by a motor on a power circuit in which the voltage varied a good deal. Some of the irregularities of voltage in the generator are accounted for by the variation in speed of the motor.

SOME TESTS ON THE VARIATION OF THE CONSTANTS OF ELECTRICITY SUPPLY METERS, WITH TEMPERATURE AND WITH CURRENT.[1]

BY G. W. DONALD RICKS, A. C. G. I., A. I. E. E.

THE general object of the tests was to afford a means of studying the behavior of direct current electricity supply meters with regard to variations in the accuracy of their indications under varying conditions of temperature, current and potential difference.

Some of the more important meters were put through a series of tests which aimed at ascertaining, 1. How the accuracy of the meter depended upon the current at various constant temperatures, all other conditions being maintained constant. 2. How its accuracy depended on the potential difference at constant current and temperature.

The first of these tests was carried out at three different temperatures—namely, about 2° C., 18° C. and 40° C., which may be fairly taken as the extreme and mean ordinary working temperatures. From the results of this test the effect of change of temperature at constant potential difference and current was ascertained. The second test is, of course, only applicable to energy meters. It was made at the maximum current and at atmospheric temperature, the pressure being varied from about 10 per cent. below to 10 per cent. above the normal value.

The tests were carried out at the City and Guilds Central Technical College upon each of the following meters, obtained direct from the makers, and not opened or in any way altered before testing: Elihu Thomson, Schuckert, Ferranti, Perry, Chamberlain and Hookham.

These, it will be seen, fairly represent the principal types of direct current meters now in general use in England.

A very fair idea of the relative advantages and disadvantages of each meter may be obtained from the accompanying table I:

TABLE I.

Meter.	Max. current in amperes.	Normal pressure in volts.	Resistance in ohms. Main circuit. At 1 ampere.	Resistance in ohms. Main circuit. At max. current	Resistance in ohms. Shunt circuit.	Power wasted at max. current. Main circuit.	Power wasted at max. current. Shunt circ't.	Power wasted at max. current. Total watts.	Fall of potential in series circuit at max. current.	Starting current per cent. of max.	Temperature coefficient.
Elihu Thomson	10	100	0.0948	0.0958	3101	9.58	3 22	12.8	0.958	1.4	−0.32
Schuckert	15	110	0.0420	0.0438	2535	9.9	4.77	14.67	0.66	1 93	−0.13
Ferranti	25	...	0.0154	0.0131	....	8.19	....	8.19	0.327	0.8	+0.07
Perry	20	...	0.00327	0.00331	....	1.32	....	1.32	0.066	1.25	−0.47
Chamberlain & Hookham	25	...	0.0137	0.0157	....	9.8	....	9.8	0.392	0.8	−0.22

The first two columns simply show the current, and in the case of energy meters the pressure for which each meter is intended. The resistance of the main circuit given in the next two columns was measured by means of a standard ammeter and a standard reflecting voltmeter, and the resistance of the shunt circuits on a Wheatstone bridge.

Considering first the Elihu Thomson meter, it will be noticed that its resistance is comparatively large, the fall of potential at 10 amperes amounting to nearly 0.96 volt. The temperature coefficient is also comparatively large, and the starting current 1.4 per cent. of the maximum current, which is, perhaps, not excessive for this class of meter, especially when used on alternate current circuits.[1]

The Schuckert has an advantage over the Thomson meter in that its resistance is very much less, reducing the fall of pressure and wasted power, but on the other hand its starting current is higher, being 1.93 per cent. of the maximum. Its temperature coefficient is also much less than that of the Thomson meter.

Turning now to the ampere hour meters, the first point to be noticed is that their resistances are very much lower than is the case with the energy meters. Not only do they save the three or four watts absorbed in the pressure circuit, but the watts wasted in the main circuit appear to be much less.

The Ferranti meter starts with a very small current, 0.8 per cent. of the maximum, and has an extremely low temperature coefficient.

The Chamberlain and Hookham meter has an equally low starting current and a moderate temperature coefficient, its resistance being rather higher than that of the Ferranti for the same maximum current.

The Perry meter has an extremely small resistance, causing a fall of pressure of less than a tenth of a volt at maximum current and absorbing only 1.32 watts. In this respect it is far in advance of all the others, but it has the disadvantages of comparatively high starting current and temperature coefficient.

PERSONAL

A SERIOUS ACCIDENT TO MR. J. H. VAIL.

On Tuesday, Sept. 7, Mr. J. H. Vail, Engineer in Chief of the Pennsylvania Heat, Light and Power Co., Philadelphia, met with an accident nearly resulting fatally. Mr. Vail was riding his wheel and came into collision with a heavily loaded ice wagon at the intersection of School Lane and Greene street, Germantown. The team was being driven on Greene street by a boy, with every indication of going straight ahead. Mr. Vail was coming down School Lane and about to turn into Greene street, when the boy driver suddenly swerved his team directly upon Mr. Vail, cutting off all opportunity for him to turn either to the right or left. While he was trying to dismount the team came immediately upon him, the pole knocking him down, the team passed over him. It did not strike him, but one of the heavy wheels passed over Mr. Vail's back and right shoulder, and only by rare presence of mind Mr. Vail jerked his head to the left side, thus saving his life. The extent of the injuries are a broken shoulder blade and several severe contusions on the back and right arm.

MR. R. W. POPE contributes to the "Railroad Gazette" an interesting letter relative to Alaska and the gold regions, based on the observations of himself and his late brother, the editor of this journal, Mr. F. L. Pope, both gentlemen having been connected with the Western Union-Pacific Telegraph line survey thirty years ago.

THE LATE HARVEY LUFKIN.—A number of the friends of the late Harvey L. Lufkin are raising a fund for the benefit of his widow, who is in destitute circumstances. A good sum has already been raised, but more will be very welcome. Contributions may be sent to Mr. J. W. Godfrey, 15 Cortlandt street.

MR. J. J. ASTOR'S smaller electric launch was run down in the Hudson River, off New York City, last week by the fast steamer "Mary Powell," and sank at once, the man in charge being saved. Mr. Astor had just landed and proposes to bring an action for damages.

BROOKLYN BRIDGE, N. Y.—The trolley cars are to cross the Brooklyn Bridge, from Brooklyn to New York and back, paying the Bridge five cents for each round trip of a car. They are to use their own motive power and build their own tracks and wires. It is a ten-year contract.

[1]Read before the British Assoc. at Toronto.

[1]See letter of Prof. Ayrton, page 251.

INVENTORS' RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPTEMBER 7, 1897.

Alarms and Signals:—

SIGNAL BOX. A. C. Robbins, San Francisco, Cal., 589,617. Filed March 26, 1897.
Consists of a device for automatically cutting the mechanism of the box out of the main circuit when not in use.

ELECTRIC SWITCH AND CUT-OUT FOR TELEPHONE BOXES. A. C. Robbins, San Francisco, Cal., 589,618. Filed March 26, 1897.
Means whereby the opening and closing of the door actuates the mechanism for cutting the telephonic apparatus and local battery in or out of circuit.

TELEPHONE TRANSMITTER FOR SIGNAL BOXES. A. C. Robbins, San Francisco, Cal., 589,619. Filed March 26, 1897.
Comprises a box having an outwardly opening door, a transmitter hinged therein, and a lug adapted to contact with and raise the outer end of the transmitter by the closing of the door.

ELECTRIC SAFETY APPLIANCE FOR RAILROADS. E. L. Orcutt, Somerville, Mass., 589,669. Filed Feb. 6, 1897.
An electric current is sent as a pilot from the engine into the section of the track into which it is about to enter, causing a communication to be given to the engineer whether the section ahead is safe.

DEVICE FOR INDICATING ESCAPE OF GAS. M. O'Donovan, Boston, Mass., 589,745. Filed May 24, 1895.
Employs a thermostat placed in proximity to the flame, a collar for supporting it, and adjustable screw normally in contact with the end of the thermostat and mounted on the collar.

ELECTRIC SIGNALING APPARATUS AND CIRCUIT. E. H. Owen, C. N. Williams and F. H. Donaldson, Garvanza, Cal., 589,746. Filed April 22, 1897.
A hotel call bell system.

ANNUNCIATOR SYSTEM. E. H. Owen, C. N. Williams and F. H. Donaldson, Garvanza, Cal., 589,747. Filed June 18, 1897.
Details of construction.

WATCHMAN'S ELECTRIC TIME-RECORDER. C. H. Phinney, Boston, Mass., 589,510. Filed Dec. 9, 1895.
An arrangement whereby, with any door or window open, the watchman is prevented from sending in the proper signal.

Conductors, Conduits and Insulators:—

ELECTRICAL JUNCTION BOX. G. Tailleur, Chicago, Ill., 589,760. Filed June 7, 1897.
Embodies pole bars for the conductor terminals provided with sockets to receive shunt-circuit plugs.

Distribution:—

MULTIPLE SERIES SYSTEM OF ELECTRICAL DISTRIBUTION. C. D. Haskins, Brooklyn, N. Y., 589,429. Filed June 8, 1896.
Adapted for use in connection with a system which does not employ a divided source of energy.

SYSTEM OF ELECTRICAL DISTRIBUTION. C. D. Haskins, Brooklyn, N. Y., 589,430. Filed July 6, 1896.
Automatic potential equalizer for multiple series systems.

TRANSMISSION OF ENERGY BY ALTERNATING CURRENTS. C. S. Bradley, Avon, N. Y., 589,556. Filed March 21, 1896.
Employs a generator having a definite rate, and a circuit containing a plurality of inductances in multiple arc, the inductances being proportioned to render the line resonant with periodic electromotive force.

Dynamos and Motors:—

ALTERNATING CURRENT GENERATOR. F. H. Sleeper, St. Johnsbury, Vt., 589,674. Filed May 21, 1896.
Of the inductor type.

BRUSH HOLDER. H. G. Reist, Schenectady, N. Y., 589,794. Filed May 24, 1897.
Comprises a box in which the brushes are mounted, an equalizer extending between the brushes, and a spring for applying pressure to the brushes.

Electro-Metallurgy:—

PROCESS OF AND APPARATUS FOR ELECTROLYZING FUSED SALTS. J. Boelsterli, Neuhausen, Switzerland, 589,523. Filed Oct. 27, 1896.
Consists in electrolyzing a fused alkali-metal salt and liberating the alkali metal exclusively at the surface of the electrolyte.

COMPOSITION OF MATTER FOR MANUFACTURING CALCIUM CARBID. S. Blum, Galveston, Tex., 589,592. Filed Feb. 3, 1897.
Composed of air-slaked lime, carbon, plumbago containing iron and potash.

PROCESS OF MANUFACTURING WHITE LEAD. H. C. Wolterеck, New York, 589,801. Filed April 9, 1897.
Employs electrolysis. Details of process.

Measurements:—

ELECTRIC METER. C. C. Schumacher and A. G. Zamel, Chicago, Ill., 589,672. Filed May 22, 1897.
Comprises a recorder provided with a balance wheel, a pinion of the balance wheel, a tooth segment engaging the pinion, an armature connected with the segment, and a magnet for attracting the armature.

Miscellaneous:—

SILICON ALLOY. G. De Chalmot, Leaksville, N. C., 589,415. Filed May 14, 1896.
Consists of an alloy of silicon with a metallic silicide.

ELECTRIC HAIR SINGER. D. Seide, Hartford, Conn., 589,445. Filed April 15, 1897.
Details of construction.

LIGHTNING ROD. E. Marshall Garnett, Kan., 589,566. Filed June 1, 1897.
Comprises an endless cable, a pair of cables connecting with the same and grounded at their lower ends, and provided at their upper ends with a plurality of points.

STATIC MACHINE. C. H. Myers and H. C. Rose, South Bend, Ind., 589,742. Filed Dec. 5, 1896.
Comprises a case enclosing the machine and a tank in the case containing a refrigerant.

ELECTRICAL IGNITER FOR GAS NGINES. Edward F. Moffitt, San Francisco, Cal. 589,509.AS ENGINES. Edward F. Moffit, Details of construction.

ELECTRO-PNEUMATIC MUSICAL INSTRUMENT. Robert W. Pain, New York, N. Y. 589,535. Filed May 13, 1896.
Details of construction.

Railways and Appliances:—

AUXILIARY ELECTRIC CONTACT. W. M. Brown, Johnstown, Pa., 589,412. Filed Feb. 23, 1897.
Embodies a metallic knife edge which can be powerfully pressed against the track rails.

TRAVELING CONTACT FOR ELECTRIC RAILWAYS. W. F. Weiss, Stockton, N. J., 589,452. Filed April 24, 1897.
The trolley wheel is carried on a transverse rod adapted to give it lateral play.

ELECTRIC RAIL BOND. G. H. Scott, Worcester, Mass., 589,485. Filed Jan. 26, 1897.
A rail bond rectangular in cross-section adapted to be fastened in place by means of bushings.

ELECTRIC MOTOR CAR. H. P. Brown, New York, 589,543. Filed March 11, 1893.
Employs an armature which will start without load.

UNDERRUNING TROLLEY FOR ELECTRIC RAILWAYS. S. H. Short, Cleveland, Ohio, 589,624. Filed July 29, 1896.
Embodies an elongated contact roller.

TROLLEY. F. W. Canales, Portland, Me., 589,693. Filed May 21, 1895.
A construction permitting the wheel to turn in a plane at right angles to the plane of its rotation.

TROLLEY WHEEL FOR ELECTRIC CARS. J. A. Crawford and T. E. Crow, Dallas, Tex., 589,702. Filed Sept. 12, 1896.
Comprises a frame, a wheel, a wheel axle, discs eccentrically journaled upon the axle, lugs upon the discs, and projections upon the frame lying in the path of the lugs.

DASH ELECTRIC HEADLIGHT. J. Kirby, Jr., Dayton, Ohio, 589,783. Filed Feb. 10, 1897.
Embodies a frame fastening in the dash board in which the casing is removably attached.

SURFACE CONTACT ELECTRIC RAILWAY. L. H. Parker, Schenectady, N. Y., 589,785. Filed Nov. 18, 1896.
The closing and opening of the surface contact is accomplished by means of an electromagnetic device carried by the moving vehicle.

CLOSED CONDUIT ELECTRIC RAILWAY SYSTEM. W. B. Potter, Schenectady, N. Y., 589,786. Filed Oct. 6, 1896.
A sectional conduit system employing electromagnetic contact devices.

CLOSED CONDUIT ELECTRIC RAILWAY. W. B. Potter, Schenectady, N. Y., 589,787. Filed Nov. 18, 1896.
Similar to above.

CLOSED CONDUIT ELECTRIC RAILWAY SYSTEM. W. B. Potter, Schenectady, N. Y., 589,788. Filed Nov. 28, 1896.
Similar to above.

CLOSED CONDUIT ELECTRIC RAILWAY. W. B. Potter, Schenectady, N. Y., 589,789. Filed Nov. 28, 1896.
Similar to above.

CLOSED CONDUIT ELECTRIC RAILWAY. W. B. Potter, Schenectady, N. Y., 589,790. Filed Jan. 2, 1897.
Similar to above.

SURFACE CONTACT RAILWAY SYSTEM. W. B. Potter, Schenectady, N. Y., 589,791. Filed Jan. 25, 1897.
A surface contact system, provided with a car having a storage battery and contact shoes, means for turning the car and means for reversing the connection of the storage battery to the contact shoes.

CLOSED CONDUIT ELECTRIC RAILWAY. W. B. Potter, Schenectady, N. Y., 589,792. Filed Nov. 18, 1896.
A safety device by which any leakage current will serve to open a switch which may by accident have remained closed.

Switches, Cut-Outs, Etc.

STARTING BOX FOR ELECTRIC MOTORS. R. B. Hirst, deceased, E. Hirst, administratrix, Brooklyn, N. Y., 589,433. Filed July 3, 1897.
Designed to obviate the necessity of an external switch for breaking the main circuit in order to stop the motor.

LIGHTNING ARRESTER. C. S. Bradley, Avon, N. Y., 589,557. Filed May 28, 1895.
Consists of an inductive device comprising two conductors connected with the outgoing and return wires of a circuit so as to oppose one another in inductive effect, under current from the generator, but assist one another with grounded currents, and a branch connection to earth, including a spark-gap on the line side of the inductive device.

ELECTRIC SWITCH. J. B. Smith, A. W. Ferrin and A. L. Clough, Manchester, N. H., 589,582. Filed Aug. 15, 1896.
Automatic cut-out switch for motors.

Telephones:—

TELEPHONIC MEASURED SERVICE SYSTEM. H. V. Hayes, Cambridge, and T. C. Wales, Jr., Newton, Mass., 589,431. Filed June 23, 1897.
Means for separately recording party-line calls at the central station.

MULTIPLE CUT-OUT FOR TELEPHONE SYSTEMS. A. B. Strowger and A. E. Keith, Chicago, Ill., 589,798. Filed Feb. 19, 1896.
Means whereby two line wires may serve to connect a plurality of telephone sets with the central exchange, and means whereby only one operator may connect at a time.

MR. E. TREMLETT CARTER, a well known English electrical engineer, recently inspected the electrical equipment of the B. & O., at Baltimore, as the London Underground Railway has adopted the style of motors that the B. & O. uses in the Baltimore tunnel. At the conclusion of his inspection, Mr. Carter said that it was the most complete and economically handled plant he had ever seen, and that he had never been in a tunnel that was so absolutely free from smoke.

SOCIETY & CLUB NOTES

EIGHTEENTH CONVENTION OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

TUESDAY MORNING.

THE Edison Association began a very successful and unusually well attended convention at the Cataract House, Niagara Falls, on Sept. 14. The proceedings were opened by President Insull, who delivered the following address:

The decision of the members of the Association at the last annual meeting to hold its eighteenth convention at Niagara Falls was naturally dictated by the world-wide interest in the work of generating and distributing electrical energy, using the famous Niagara River as a prime motor. In assembling at a spot where so much can be learned by those engaged in electrical business, we are, as an Association, paying the highest tribute that we can to the wonderful work of those who have had the courage as capitalists and engineers to design and build a plant which has given a great impetus to the economical production of electric current, not only by means of water as the prime motor, but by all other methods for the production of electrical energy. We cannot all have the advantage of a large water power to assist in the economical production of our product right at our threshold, but in studying the methods employed here at Niagara Falls there is much information that we can take away with us which will lead us to concentrate our works at the most economical point of production in the various cities in which we live, and we can take advantage of the methods of distribution here employed to distribute our current to distant points where we desire to use it, far more economically than we can produce it at those distant points themselves. The question is often asked by those engaged in the electric light and power business why the companies known as "Edison Illuminating Companies" or "Edison Licensees" should find it necessary to combine themselves into an association. This question is best answered by the fact that the Edison Illuminating Companies all operate under practically the same form of contract with the company that controls the Edison patents, namely, the Edison Electric Light Company. In the main they purchase their goods under contract, from the same licensed manufacturer of the patent owning company, namely, the General Electric Company, and as there is but one Edison Company in each particular city, the interests of these various companies are naturally mutual. When I remind you that the various companies which we, either as officers or employees, have the honor of representing here, have invested in their business more than $105,000,000, it will be readily appreciated that it must be greatly to the advantage of the various properties which we operate that we should meet from time to time to exchange ideas as to the proper conduct of our business, and that we should continue an organization to watch over our interests in our dealings with the patent owning and manufacturing side of the Edison business.

At what happily would appear to be the close of an unparalled period of industrial depression the various Edison Illuminating Companies have certainly cause for mutual congratulation. Notwithstanding this long period of paralysis of industrial enterprise, they have, with hardly any exception, been able to show good earning capacity and to pay to the holders of their securities a substantial return on their investment. This is partly owing to the inherent merit of our business, partly to the wise foresight of the illustrious inventor whose system this business is based on, and partly to the conservatism of the original projectors of the Edison lighting and power business, who insisted that the Edison Illuminating Companies should be established on a sound financial basis.

This experience during the depressed times will necessarily lead investors to the conclusion that the securities of the Edison Illuminating Companies are amongst the most desirable of local investments, as if it is possible to earn substantial returns on capital invested during such periods of business disturbances as that which we have recently gone through, surely we can look forward to laying up a substantial surplus to provide against a "rainy day" during times of prosperity which all of us hope and some of us think we are now entering upon.

The use of large generating units in the large stations for the production of electrical energy inaugurated but a few years ago and the necessity of extending the field of our operations into distant portions of our territory has forced upon many of us the desirability of employing more economical methods of transmission with a view to the abandonment of small and expensive stations and the concentration of our production of current at the point of greatest economy. This matter was touched upon to a certain extent during the last convention. A number of our companies are now spending large sums of money on these lines, and as a result of the importance that this subject has assumed, it is but natural that a considerable portion of our time will be occupied in deliberating on this subject.

In connection with the matter of economical transmission the subject of economical storage is naturally of importance, and we should, in the course of our proceedings, be able to obtain considerable information on the advantages of the use of the storage battery in connection with the Edison system from those who have had the courage of their opinions and have invested largely in storage battery plants. I think we all concede the advantage to be obtained from the use of the storage battery from the storage point of view only, but some of us are still in doubt as to our ability to save sufficient money from their use to justify the large investment in capital they call for.

A subject of prime importance with the economical production of our product is the basis upon which we shall sell it to our customers. It should be remembered that we are engaged in a public business, and that our companies have duties to perform to the public as well as money to earn for our security holders. In fulfilling our obligations to the public the question of the basis of charging for our product is the all important one. This is a matter which on previous occasions has received our earnest attention, and is one on which there will undoubtedly be earnest discussion on this occasion.

For several years past some of the larger Illuminating Companies, members of this Association, notably those of Boston, New York and Chicago, have been in the habit of comparing the details of cost and selling price of their product, their accounts being kept on the same basis, as near as local conditions permit. The information obtained, so far as my experience goes, has been of great advantage in enabling the companies in question to reduce their cost and in assisting them to an intelligent decision as to the policy to adopt toward their customers. It seems to me that it would be advantageous to the members of this Association if a uniform system of accounts were adopted and arrangements made to compare the results obtained by the various companies operating under similar conditions. In putting such a scheme into operation a number of difficulties would naturally have to be overcome, such as the differences in local conditions and the necessity of carefully guarding information of so confidential a character, but I would suggest the desirability of the Association instructing the executive committee to take this matter up, with a view of formulating a plan which might be tried experimentally.

The changes that have taken place from time to time since the formation of this Association have rendered it desirable that some modifications should be made in your by-laws. A report will be made to you during our meeting, setting forth the changes suggested, which have been discussed and approved by the executive committee of your Association.

The main business of your executive committee during the past year has been the negotiating with the General Electric Company of a contract and specifications with relation to the incandescent lamps used by the Edison licensees who are members of this Association. As a result a lamp testing bureau has been established at the lamp factory at Harrison, N. J., which bureau is under the control of this Association and is operated for its account by Mr. Wilson S. Howell. A number of our members have taken advantage of the arrangement made, and we believe that considerable benefit will accrue to those who arrange to purchase their lamps under the contract in question. Great credit is due to the chairman and members of the executive committee for the results they have been able to achieve, and they are certainly deserving of our thanks for the time and money they have spent in this matter for our benefit. I think for the first time in the history of the electric lighting business we are now able to obtain lamps made according to specifications agreed upon, and the result must be an improvement in our service and a saving of money to our central station companies. The details as to this matter will be carefully dealt with in reports by Mr. C. L. Edgar, chairman of the executive committee, and Mr. Wilson S. Howell, the testing officer in charge of the bureau at Harrison.

The relations of the Edison licensees with the Edison Electric Light Company and its licensed manufacturers, the General Electric Company, have, during the past year, been of the pleasantest character. This is probably owing to the fact that those operating the General Electric Company since the consolidation of the Thomson-Houston Company and the

Edison General Electric Company have had fuller opportunity, as time has gone on, to appreciate the importance of the Edison licensee business to the patent owning and manufacturing interests.

The matter of patents continue to be in far from a satisfactory condition, the licensees receiving very little protection in the enjoyment of the exclusive privileges under the Edison patents, which they have every reason to look for in view of the large amount of royalty paid by them to the parent company. It is doubtful whether the Edison Electric Light Company or the General Electric Company can be held responsible for this state of affairs, as they have continued to spend very large sums of money in the prosecution of their patent rights in the courts.

It is to be regretted that many of the electrical manufacturing companies continue to foster opposition central station plants in territory already covered by good paying illuminating properties with the result of seriously affecting the credit of the customers upon whom the manufacturers must rely for trade, if they desire to create a permanent manufacturing business. We have all of us suffered more or less from this policy of the manufacturing interests, and while in some cases there may possibly be a temporary advantage to one or another manufacturer, it is natural for us to wonder what permanent advantage can come to the manufacturing interests as a whole by the adoption of methods which would seem to have in view the ultimate destruction of the goose that lays the golden egg.

With the many changes that must of necessity take place in so new a business as the electric light and power industry, the question is often raised as to whether or not our plant is of a permanent character. A close examination of the Edison system must bring home to any one the fact that the wonderful inventive and engineering talent displayed by Mr. Edison in his early work has given us the advantage of a system that is of the utmost permanency. Our main investment, in the larger cities at least, is in our underground work, and if you will look over the records of the various companies using the Edison system, I think you will find that their underground work is as useful to them now as when it was laid, and it seems to me that there is no reason for us to fear that this condition will change in the future. We may have different methods of illumination; we may get a higher voltage lamp; we may find that the current of the future will not require as large a cross section of copper as in the past, but I doubt if you will find that any method of distribution will be invented that will supplant that which we are using; and if such be the case, we should rather welcome than fear new inventions, feeling that in our own particular cities we are the most desirable purchasers of any inventions which may lessen the cost of electrical energy to our customers. When those of us who have been connected with this great industry from its early childhood recall the fact that scientists and inventors on both sides of the Atlantic persistently condemned the scheme originally laid out by Mr. Edison, we must, as central station managers of to-day, feel that we owe a deep debt of gratitude to him for his courage in insisting that the only practicable method of distribution of electrical energy was by the use of a constant pressure and a varying current when everybody else was talking a constant current and a varying pressure. This is no occasion for invidious comparisons, but with every desire to pay the highest tribute to the many brilliant men who have contributed to the success of the business of manufacturing and distributing electrical energy, we venture to claim that their work is all subordinate to the master mind who persisted in the early experimental days at Menlo Park in working on a multiple arc system, without which (with the exception of the series arc light) no form of electric light or electric energy could be commercially operated to-day.

MR. R. R. BOWKER felicitated the president on his address and the Association on the fact that the National Electric Light Association had also chosen Mr. Insull for its President this year, thus showing the essential harmony that existed throughout the art. A vote of thanks to Mr. Insull was adopted.

MR. L. A. FERGUSON, of the Chicago Edison Co., read a paper on "Economy in Distribution of Electrical Energy," in which he reviewed ably the state of the art, and expressed an opinion as to its future. He thought the day had passed for several sectional stations in a city and believed in one main station for making the current. Reviewing the possible methods, he said that the advantageous system was one embodying machines built to deliver both three-phase alternating and direct current at the same time, thus meeting the needs of transmission and the local three-wire requirements. He found rotary transformers very useful in such sub-stations fed by these generators. The other two methods, which he regarded with less favor, were those of using large three-phasers with sub-station transformers, etc., or of converting direct current in the main station into three-phase for the transmission to the sub-stations.

In closing his paper Mr. Ferguson noted that storage batteries might be used as auxiliaries, but would not increase the efficiency of the system. He held that the real field for the storage battery was in employment at the main station as an auxiliary in case of emergency and at the centre of distribution or sub-stations for the same purpose. He gave figures from current practice showing the comparative cost of a steam sub-station as against the rotary transformer sub-station.

MR. R. R. BOWKER said that his recent inquiries in Europe showed results confirming generally the position taken by Mr. Ferguson, but he pointed out that the investment already made in steam sub-stations was by no means rendered useless by the new method, as, so long as the lighting load was characterized by a high peak, the steam stations could be profitably operated to carry the peak portion of the load.

MR. H. F. PARSHALL, of London, discussed the English distribution systems for power and light, noting the high periodicity chosen in most of the English alternating distributions and the large proportion which incandescent lighting formed of the total load in these systems. He did not see an advantage for lighting alone of changing the alternating current to direct current for distribution to consumer.

MR. C. S. EDGAR pointed out that the choice of either of the three generating arrangements described by Mr. Ferguson for any given case would depend upon the proportion of alternating current and direct current in the total demand of the consumers, so that the different choice of method in Chicago and in Brooklyn had been controlled by local conditions.

MR. W. S. BARSTOW described very fully the new Brooklyn generating station at Bay Ridge, the three-phased transmission at high pressure of alternating current and the transformation of the three-phase current by means of rotaries and by synchronous motors driving arc dynamos into low tension direct current for distribution on the Edison three wire system and high tension direct current for series arc lighting. The distance to one sub-station by the route now used is twelve miles, and the service is perfect. A storage battery is placed in one station as a reserve.

MR. S. DANA GREENE pointed out in reply to Mr. Parshall that American city conditions differ from those of London and other English cities in there being an important demand for direct current for many services for which alternating current was not available. He discussed and described some details of rotary sub-stations, particularly the independent regulation of pressure at each station according to its own requirements.

MR. J. W. LIEB emphasized the necessity for the distribution of direct current by instances from both European and American practices. He incidentally noted the superiority of direct current arcs over alternating arcs; and he described a temporary transmission used by the New York Edison Company in which a two-phase motor supplied by high tension currents drove a pair of low tension direct current dynamos feeding into the Edison three wire mains at a place where there was a large demand for current.

PRESIDENT INSULL stated that the Chicago Edison Company's experience had proved the advantage of concentration of generating plant. He remarked that the instances of sub-station distribution which had been mentioned in the discussion were all located in large cities, but that the principle was equally applicable to smaller stations and that many of these might with advantage be rearranged or extended in this way. He recommended the study of the method to all present, with a view to its possible application in their own cities.

MR. BOWKER summed up the discussion by saying that no distribution would fit the conditions of central station work to-day, unless it possessed the flexibility and the wide range of application which characterized the original three wire system, and that it seemed to be impossible to secure these in conjunction with long distance transmission except by the use of rotaries; and Mr. Ferguson, in closing, adopted Mr. Bowker's expressions.

TUESDAY EVENING.

MR. GEORGE R. STETSON read a paper describing and illustrating the use of the photometer in the gas industry; the unit of measurement being the English standard candle and the photometer being of the Bunsen type.

MR. J. W. LIEB, JR., in the discussion referred to the Lummer-Brodhun photometer and the Hefner von Alteneck standard of light, with incandescent lights as secondary standards; and compared certain details of these devices. He also called attention of the members to the arrangements which had been made for the supply of calibrated incandescent lamps of sixteen candle power for practical use as station standards.

MR. S. DANA GREENE noted the difference among authorities as to classification of incandescent lamps; some classifying lamps by means of spherical candle power and others adhering to the customary classification by mean horizontal candle power, which subject was further discussed by Mr. John Howell and Mr. R. R. Bowker.

MR. CARYL D. HASKINS presented an illustrated paper describing "Recent Developments in Electrical Measuring Devices," the devices being a prepayment watt meter; improved station watt meters and tell tale dials for the same; storage battery watt meters showing the state of charge of a storage battery; and new switch board instruments. The discussion following was generally taken part in by the members and was in the main an exchange of experiences with meters.

The committee on Acetylene gas and Welsbach burners presented a report, which was accepted.

WEDNESDAY MORNING.

The report of the treasurer was presented and accepted.

MR. J. W. LIEB, JR., read a paper on "Methods of Charging For Current." He discussed ten methods in use as follows: Flat rate. Flat rate with connection to circuits shut down at agreed hours. Discounts based on duration of demand, based on the stated time of closing of the customer's premises. Special rates for motors. Discounts on gross bills. Discounts based on average use per day of units installed. The Hopkinson system, a fixed annual rental based on customer's load factor, and an additional charge per unit used. Double discounts, one on gross bill and a second discount based on average use of installation. The "Wright" system, with demand meter. The Kapp, or double rate system; maximum rate being charged at the hours of the peak of the station load and a lower rate during the remainder of the twenty-four hours. And he presented a set of tables showing the rates and methods of charging of twelve large stations.

MR. A. S. KNIGHT, of Boston, in a written discussion, acknowledged the value to the industry of the analysis of costs, which had been made and published by English electric light men; particularly Mr. Arthur Wright; admitted that American rates had been generally made with too little analysis of cost of product, but objected that the Wright system went too far in the other direction by disregarding the wholesale feature of sales to large consumers.

MR. W. S. BARSTOW read a written discussion and showed diagrams which emphasize the effect of cost of product at different hours of the demand variation from hour to hour; and accepted the value of a high load factor in reducing possible selling price. He recommended the double rate system of charging with a constant minimum rate in effect at all but the "peak" hours; the minimum rate being calculated to begin with and any readjustment toward lower rates due to reduced cost of production to be made by lengthening the hours during which the minimum rate should be in effect. The "Kapp" system and a Kapp meter made from one of the common type of meters by the addition of a self-winding clock attachment, were his preferences as to the manner of applying the double rate.

A general discussion ensued, questions being asked of the delegates who had spoken in order to elucidate their methods of apportioning costs of production, and the subject being one of special interest it was resolved to take it up again at the evening session.

WEDNESDAY EVENING.

The discussion was continued in general, many delegates taking part, the experiences and opinions of each being given. To such an extent were confidential statements of experience gone into that even the official stenographer was instructed to take no notes.

THURSDAY MORNING.

MR. CHARLES E. PATTISON presented a paper entitled, "Storage Battery Progress and Results in the Edison Boston Stations." The paper embodied a record of three years and six months' experience with the first battery, two years and three months with the second and one year with the third. His conclusions were that his company's experience to date indicated great benefits from the batteries and that while they had weaknesses, the expense of maintenance was not so great as for some of the other apparatus in use. The most notable benefits were the better regulation of pressure on the system, particularly the elimination of fluctuation due to intermittent motor loads, such as direct connected elevators; the improvement of generating economy due to the custom of charging the batteries during hours when the load would otherwise be light and the reduction of expense hitherto necessary in keeping furnaces banked and engines ready for emergency use.

The discussion by Mr. R. R. Bowker, Mr. W. S. Barstow, Mr. J. W. Lieb, Jr., Mr. L. A. Ferguson, Mr. Samuel Scovil and others showed differences of opinion among the members having experience with batteries as to which of the advantages to be gained by their use was of primary importance, the expressions varying between those given by Mr Pattison and that of another delegate who was of the opinion that the immediate availability of the battery as a reserve in case of accident to the generating plant was its principal recommendation.

MR. J. W. LIEB, JR., presented the report of the committee on storage batteries, which, among other matters, contained a recommendation that a rating of battery capacity more conservative than that heretofore in use by the manufacturer should be adopted.

The report of the executive committee and the report of the Lamp Testing Bureau, presented by Mr. Wilson S. Howell, the chief of the Testing Bureau, were read and referred to the afternoon session for discussion.

THURSDAY EVENING.

The reports referred from the previous session were fully discussed, and after electing officers and executive committee for the ensuing year, the convention adjourned.

The following is the list of officers elected: President, Samuel Insull, Chicago, second term; vice president, R. R. Bowker, New York, second term; secretary, Wilson S. Howell; treasurer, W. S. Barstow, Brooklyn; executive committee, Charles L. Edgar, Boston; Alex. Dow, Detroit; George R. Stetson, New Bedford; J. W. Lieb, Jr., New York; Samuel Scovil, Cleveland.

Among those present were the following:

Geo. A. Redman, Rochester, N. Y., Gas and Electric Co.; A. M. Robertson, secretary and general manager, Minneapolis, Minn., General Electric Co.; J. S. Crider, Edison Co., Cumberland, Md.; A. W. Field, secretary and manager, Columbus, O., Edison Co.; Geo. H. Finn, Edison Electric Light and Power Co., St. Paul; Wm. G. Beale, counsel, Chicago Edison Co.; Warren H. Girvin, general manager, Edison Light and Power Co., Syracuse, N. Y.; Geo. W. Davenport, treasurer, Electric Light and Power Co., Syracuse, N. Y.; W. M. Anthony, comptroller, Chicago Edison Co.; Alex. Dow, general manager, Edison Illuminating Co., Detroit, Mich.; J. W. Lieb, Jr., general manager, Edison Co., New York; C. L. Edgar, vice-president and general manager, Edison Co., Boston, Mass.; Hoyt Post, director, Edison Co., Detroit and Grand Rapids, Mich.; Leon H. Scherck, Edison Co., New Orleans, La.; Charles R. Price, treasurer, New Bedford, Mass., Gas and Edison Light Co.; John W. Howell, E. G. E. Lamp Works, Harrison, N. J.; R. R. Bowker, first vice-president, Edison Electric Illuminating Co., New York; J. Colby, treasurer and general manager, Des Moines, Ia., Edison Light Co.; M. A. Beal, secretary and treasurer, Forest City Electric Light and Power Co., Rockford, Ill.; W. S. Smith, superintendent, Toledo, O., Consolidated Electric Co.; W. H. Johnson, secretary and manager, Edison Co., Philadelphia, Pa.; Charles G. King, Chicago Edison Co.; Wm. Chandler, Edison Electric Co., Sault Ste. Marie, Mich.; Samuel Insull, president, Chicago Edison Co., Brooklyn, N. Y.; Chas. E. Pattison, Edison Electric Illuminating Co., Boston, Mass.; L. A. Ferguson, Chicago Edison Co., Chicago, Ill.; Geo. P. Magner, treasurer, Newport Illuminating Co., Newport, R. I.; Luther Stieringer, Edison Electric Co., New Orleans, La.; T. C. Martin, The Electrical Engineer; John B. O'Hara, Western Electrician, Chicago, Ill.; John Kruesi, General Electric Co.; John McGhie, General Electric Co.; S. D. Greene, General Electric Co.; John Jay Abbott, Chicago Edison Co.; W. H. Francis, Boston Edison Co.; C. C. Perry, Indianapolis Electric Light and Power Co.; Geo. R. Stetson, president, New Bedford, Mass., Gas and Edison Light Co.; Chr. Wustenfeld, manager, Elgin City, Ill., C. & A. Ry. Co.; A. S. Knight, Edison Co., Boston, Mass.; James T. Humbird, Edison Co., Cumberland, Md.; Aug. Smith, president, Appleton, Wis., Electric Light and Power Co.; Martin J. Insull, Sargent & Lundy, Chicago, Ill.; R S. Hale, Boston, Mass.; Chas. Batcheler, Chas. D. Shain, Electricity; H. T. Edgar, W. M. Habishaw and Wallace S. Clark; W. S. Barstow, general superintendent, Edison Co., Brooklyn, N. Y.; J. R. Lovejoy and M. K. Eyre, General Electric Co.; E. A. Doty, president, and R. C. Peabody, secretary and treasurer, Brooklyn Edison Co.; C. R. Huntley, George Urban and H. G. Stott, Buffalo General Electric Co.; R. Van Trump, Wilmington (Del.) Edison Co.; J. G. Crossman, electrician, Atlanta Edison Co.; S. Scovil, vice-president, Cleveland Edison Co.; W. A. Stadelman, Elwell-Parker Co.; Prof. S. H. Short and H. McL. Harding, Walker Mfg. Co.; I. L. Roberts and O. E. Dunlap, Niagara Falls; T. C. Frenyear, Buffalo; Allen R. Foote, Tacoma Park, D. C.

CONVENTION NOTES.

ELECTRICAL ILLUMINATION OF THE WHIRPOOL RAPIDS.

ONE of the novel sights vouchsafed to the members attending the convention of Edison Electric Illuminating Companies at Niagara Falls was afforded by an experiment arranged between Supt. J. K. Brooks of the "Great Gorge Route," Mr. Luther Stieringer and the General Electric Company. Briefly it was the illumination of the Whirlpool Rapids by powerful searchlights. The idea originated with Mr. Luther Stieringer, whose experience with searchlight effects on moving waters gained from the electric fountains at the World's Fair at Chicago, which he designed, enabled him to gauge the probable success of his experiment. Mr. Brooks arranged the car and the lights and provided the current, while the General Electric Company furnished the searchlights and colored screens.

The illumination was merely in the nature of a trial demonstration of the feasibility of realizing Mr. Stieringer's idea, which comprehends ultimately the illumination of the Whirlpool Rapids nightly during the season, on a very much larger

and more substantial scale. The methods adopted in this instance were somewhat crude, owing to the shortness of time in which arrangements had to be made.

Six standard General Electric Company's searchlight lamps were employed. They were set in six plain wooden boxes, painted dead black inside. Back of each arc lamp, attached to the back of the box, was a polished silvered reflector. The boxes were placed on one of the flat cars of the Great Gorge Railway and the lights were controlled by a rheostat also on the car. A start was made from the Cataract House at 8:30 p. m. on Wednesday night in special cars under the immediate charge of Supt. Brooks. Many of the party had no idea of what they were about to contemplate. Arrived opposite the point in the Whirlpool Rapids where the movement is most turbulent the lights on the cars were suddenly extinguished. The moon had not risen and the gorge was a huge cave paved with a hurrying, leaping mass of grayish water and roofed with the almost black sky. The scene was impressive.

The small switch on one of the uprights of the car was suddenly closed by Mr. Brooks. Instantaneously the beams of light concentrated into one, flashed out upon the Rapids. The effect thus produced evoked admiration from the favored spectators. The intensity of the white light upon the masses of tumbling, roaring waters was more than magical. It was a new view of the Rapids, and conveyed perhaps a better idea of the force and violence of the current than can be gained under the light of day.

To endeavor to improve on this seemed an anti-climax, but Mr. Stieringer had another treat in store. He had provided a series of colored screens to see what effect colored beams would give to the water. The red screen was lowered in front of the reflectors. The water now assumed an almost blood red hue. From the cars this burst of color in the inky blackness of the surrounding was weird. From the top of the gorge bank the effect was almost diabolical.

The lamps were left lighted during the return journey, throwing colored beams on the foliage, and no part of the Whirlpool Rapids but was momentarily illuminated by the concentrated beam of white light. The experiment was such as to demonstrate that no visitor to the Falls hereafter will care to go away without seeing the beautiful and novel spectacle of the illumination of the Rapids.

THE NIAGARA CONVENTION is said by the Edison men to have been the most successful held. The attendance was large, the papers and discussion were excellent, and the entertainments delightful. All the reports of improving conditions of business were highly encouraging and many plans of extensions came to the surface. President Insull is deservedly to be congratulated, not only upon the success of the meeting, but upon the honor paid him of re-election.

ONE OF THE FEATURES of the convention was the entertainments organized under the charge of Mr. Wilson S. Howell. Tuesday, Wednesday and Thursday mornings there were tally-ho rides for the ladies, of whom some twenty or thirty were present. On Tuesday afternoon the Niagara power house was visited. Wednesday afternoon a splendid trolley ride was had from Chippewa to Queenston on the Canadian side and Lewiston to the hotel, on the American side coming up the Gorge Road. On Wednesday evening a large party went down the Gorge Road to the Whirlpool Rapids to see Mr. Stieringer's experiments with colored search lights. Thursday morning an early trip was made on the "Maid of the Mist." And so it went on till Friday morning came, when the convention broke up and hied home.

DR. COLEMAN SELLERS and Mr. L. B. Stillwell were very kind in the attentions shown by them to visitors to the power house, many of whom are deeply interested in the practical side of the transmission work.

PROF. S. P. THOMPSON dropped in by chance from the Rockies on Wednesday evening and went on the same night to spend the following day with Mr. Steinmetz at Schenectady. The Dublin delegation attending the street railway meeting made also many acquaintances among the Edison men through Mr. Parshall.

THE EDISON BADGE had a portrait of "the old man," of whom also a good picture appeared on the Cataract House dinner menus.

MR. W. S. BARSTOW, secretary, is entitled to many thanks for his care and kindness to visitors and supply men attending the convention, who, although not given the password for the meetings, were shown every attention and made to feel quite at home.

THE GENERAL ELECTRIC COMPANY was well represented at the convention of Edison Electric Illuminating Companies as befitted its position in regard to them. The representatives in attendance were S. Dana Greene, H. W. Darling, John Kruesi, C. T. Hughes, M. K. Eyre, J. McGhie, A. D. Page, John W. Howell, C. D. Haskins, F. M. Kimball, S. B. Paine, W. S. Andrews and W. J. Clark. In one of the rooms of the Cataract House, directly behind the convention hall, the General Electric Company made an exhibit especially for the Edison people. Upon a switch board were mounted examples of their incline coil instruments, the edgewise instrument for feeder board service, a large "G 2" astatic ammeter for recording the total output of stations calibrated to 2000 amperes, a direct current astatic ammeter. A sample of the new Thomson recording watt meter especially designed for use by Edison Electric Illuminating Companies was also shown, as well as a lamp inspectors' indicating watt meter. Upon a table were laid samples of the new porcelain cutouts developed by the General Electric Company, sections of its wires and cables and examples of underground junction boxes and distribution boxes. To explain the manufacture of type "H" transformer, there were shown the component parts of a transformer in the different stages of manufacture. The exhibit also comprised samples of the single solenoid arc lamp and of the lately developed alternating current enclosed arc lamp. The exhibit was completed by two one-horse power motors, one for 500 volts and the other for 220 volt circuits. The room was hung with the diplomas which the company has taken at different expositions and photographs of some of its more important works. A full supply of literature was provided for the use of the delegates. For the Street Railway Association the company made no separate exhibit. It was represented by Mr. W. G. Clark, the manager of its railway department, and Mr. H. Beach.

DR. W. M. HABIRSHAW was present in the interests of the India Rubber and Gutta Percha Insulating Company, which is now doing a large amount of new work for the Niagara power house and transmission purposes.

GENERAL INCANDESCENT ARC LIGHT COMPANY, of New York City, made an excellent display of their admirable specialties in one of the parlors of the Cataract House. It was under the charge of Mr. E. Lavens, general manager, assisted by Mr. H. Swoboda, the electrician of the company. It included a full line of their "Unique" long life arc lamps, some of which have burned as long as 165 hours, while their length is only twenty-seven inches in the "Bijou" forms. There are many notable features of simplicity about the mechanism of the inner globe and the devices for adjustment and renewal. The lamps are very handsome in make and finish and in large use by lighting companies, notably several of the large Edison. The company also showed their well known "Quick Break" types of blade switches, with great carrying capacity, instantaneous action, the breaking blade light with high tension spring and so small an arcing flash that the blade stands prolonged use. Other excellent devices shown were the Bergmann flush push switches, the Bergmann attaching plug, with lidded flush receptacle, the Bergmann volt meter and ground detector switches, only the dial and pointer showing on the face of the board; and other standard and popular apparatus for central station work.

FIFTEENTH ANNUAL CONVENTION OF THE NEW YORK STATE STREET RAILROAD ASSOCIATION.

THE fifteenth annual meeting of the New York State Street Railway Association was held at the International Hotel, Niagara Falls, N. Y., Sept. 14, 15 and 16, 1897.

PRES. J. TRACY ROGERS, of Binghamton, called the meeting to order on Tuesday morning at 10:45 o'clock.

The following gentlemen were in attendance at the meeting: Boyle, John W., president Utica Belt Line Street Railroad; Brewster, J. C., superintendent N. F. & S. B. R. R. Co.; Cahoon, J. B., general manager Elmira & Horseheads Railway Company; Clark, J. E. P., general manager Binghamton Railroad Company; Cooper, H. S., Schnectady Railway Company; Cole, Wm. W., West Side Railroad Company, Elmira; Cleminshaw, Charles, president Troy City Railway; Danforth, R. E., Buffalo, Bellevue & Lancaster Railway; Ely, W. Caryl, president N. F. & Buffalo Railway Company; Evans, H. C., Nassau Electric Railroad, Brooklyn; J. H. Stedman, Rochester, Railway Company; Fearey, Thomas H. Buffalo, N. Main St. & Tonawanda Railway Company; Havens, Wm., superintendent Citizens Street Railway Company, Fishkill-on-Hudson, N. Y.; Heller, W. M., Lewiston & Youngston Frontier Railway, Lewiston, N. Y.; Charles B. Hill, Niagara Falls & Suspension Bridge Railway; Johnson, A. L., president Nassau Railroad, Brooklyn; Johnson, Henry A., Metropolitan Street Railway Company, New York; Morgan, Godfrey, Buffalo St., Main St. & Tan. Railway Company; Marshall, C. K., N., F. & B. Railway, Niagara Falls, N. Y.; McCabe, Ambrose P., Metropolitan Street Railway Company, New York; Mooney, F. P., C. & H. Traction Company, Cortland, N. Y.; Maloney, F. G., Elmira & Horseheads Railway Company; Maffitt, John

H., the Rapid Transit Railway Company, Syracuse, N. Y.; McCormack, J. H., general superintendent Brooklyn Heights Railway Company; McNamara, John W., the Albany Railway Company; Newton, Henry S., Syracuse Rapid Transit Railway Company; O'Connor, Edmund, attorney of Association; Porter, B. W., Saratoga Traction Company; Porter, Alex J., director N. F. & S. Railroad; Penington, T. C., secretary American Street Railway Association; Rogers, G. T., president Binghamton Railroad Company; Sliney, George H., Nassau Railroad Company; Smith, Charles H., superintendent Troy City Railway; Story, C. B., Hoosic Railway Company; Seixas, E. F., Amsterdam Street Railway Company; Vanhorn, Burt, N. F. & B. Railway; Fearey, Thomas H., president Canandaigua Electric Railroad Company; Wheatly, W. W., secretary Brooklyn Heights Railroad Company; Watson, Henry M., president Buffalo Railway Company; Deming, Peter C., Buffalo Railway Company, Buffalo, N. Y.; Nicholl, T. J., Rochester Railway; Read, John A., Tonawanda Railroad Company; Waite, E. B., Tonawanda Railroad Company; Phillips, W., Niagara Falls Park and River Railway, Niagara Falls, Ont.; VanEttan, Ames, Kingston City Railroad Company, Rondout, N. Y.; Barnes, C. R., inspector State railroad commission, Rochester, N. Y.

Allison, Giles S., St. Louis Register Company; Toby, A. E., the Pennsylvania Steel Company; Adams, H. E., Central Electric Company; Beach, R. H., General Electric Company; Wm. J. Clark, General Electric Company; Evans, H. C., the Johnson Company, New York, N. Y.; Fearey, Thomas H., General Electric Company; Granger, J. A., New York Car Wheel Works; Haskell, G. W., J. G. Brill Company; Hollbrook, Percy, Weber Joint Manufacturing Company; Jackson, Geo. J., National Conduit and Cable Company; Lawless, E. J., American Car Company; Long, E. T., Peckham Motor, Truck and Wheel Company; Morris, Elmer P., McGuire Manufacturing Company; MacGovern, Rossiter, MacGovern & Co.; Morrell, Frank A., Sterling Supply and Manufacturing Company; Manson, George T., the Okonite Company; Pugh, D. W., the Stephenson Company; Polk, R. K., William Wharton, Jr., & Co., Philadelphia; Ransom, H. N., Consolidated Car Heating Company; Sheble, Edison-Brown Rail Bond; Swan, G. W., John A. Roeblings Sons Co.; Ten Broeck, Wm. H., Diamand Truck and Car Gear Company, Kingston, N. Y.; Vosburgh, A. C., the New Process Rawhide Company, Syracuse, N. Y.; Vincent, C. A., vice president the Ball & Wood Company, New York; Walsh, C. N., McIntosh, Seymour & Co., New York, N. Y.; Watson, H. D., the Edw. P. Allis Company, Milwaukee, Wis.; Potter, D. F., General Electric Company, Buffalo, N. Y.; McGhie, J., General Electric Company, New York, Peckham, E. Peckham Truck Company; Estey, F. A., R. D. Nuttall Company; Sharp, Edward P., Buffalo, N. Y.; Smith, Pemberton, New York Car Wheel Works; Shippy, H. L., John A. Roeblings Sons & Co.; Wood, Charles N., R. D. Nuttall Company; Randall, F. C., Christensen Engineering Company, Hartford, Conn.; Vosburg, A. C., secretary and treasurer the New Process Raw Hide Company.

Anderson, Edgar P. Dublin United Tramways Company; Beeton, S., Dick, Kerr & Co., Hove, Sussex; Anderson, Wm., secretary and manager Dublin United Tramways Company; Baker, Frank M., Cole, Ashley W., DeFriest, George W., State railroad commissioners; Concanon, J. B., Dublin, Southampton, Barcelona & Tramway Union Company, London, Eng.; Dick, inson, Alfred, European Tramways, Birmingham, England; Flett, George, managing director Dick, Kerr & Co., London; Murphy, J. F., Dublin Tramways, Dublin, Ireland; Murphy, Wm., Martin, Dublin & Belfast Tramway, Dublin, Ireland.

THE PRESS—Electricity, Charles D. Shain; The Electrical Engineer, T. C. Martin; Electrical Review, Charles W. Price; Electrical World, L. H. Parker; Street Railway Journal, Jas. H. McGraw and W. H. Taylor; Western Electrician, J. B. O'Hara; stenographer, T. E. Crossman; Street Railway Review, F. S. Kenfield.

THE RAILWAY COMMISSIONERS of the State, Messrs. Ashley W. Cole, C. R. De Friest and F. W. Baker, were present and took a close interest in all the proceedings.

PRESIDENT ROGERS delivered a long and able address in review of the affairs of the Association. He spoke of the poor earnings of the past year, as the most discouraging since the beginning of the "rapid transit," but regards prospects as brighter. Owing to liberal expenditures, street railroads were now earning less per car mile than under the horse car period, but it was also true that it was the first year for some time that a receiver had not been asked for to take charge of some road in the State. He reviewed the various questions of interest to the members and spoke of the Association as having proven a tower of strength to its members.

SECRETARY ROBINSON read the report of the executive committee, showing a membership of no fewer than forty-eight street railway companies, receipts of $7,687 and a balance of $1,361.

MR. W. W. WHEATLY, of Brooklyn, read a paper on "How Can We Increase the Efficiency of Employees?" which was favorably discussed by Mr. Cahoon and Mr. Anderson, of Dublin.

MR. W. J. CLARK then presented a most valuable paper full of statistics entitled: "A Decade of Electric Railway Development," in which, by a series of exhaustive tables and comparisons, he brought out a number of points in favor of the electric street railway system of to-day.

MR. T. J. NICOLL, of Rochester, presented a forcible argument in favor of a complete and careful mileage account, his paper being "The Advantages of a Car Mileage Record."

MR. W. W. COLE, of Elmira, in a paper entitled, "Facts and Fancies of Railroads," made a clever and vigorous arraignment of newspaper yarns about the street railway and the visionary ideas of municipal ownership.

MR. H. S. NEWTON, of Syracuse, in a paper on "How To Obtain the Best Results in Track Building," explained some excellent ideas in track construction and "bonding."

JUDGE MCNAMARA discussed this and the preceding paper.

MR. C. L. ROSSITER'S paper on "The Advantages of Up-to-Date Street Railroad Service," was read in his absence by the secretary and was a forcible argument drawn from Brooklyn experience, why fares should not be reduced, as they had been really reduced very materially already, in longer rides, better service, etc.

MR. R. DUNNING, of Buffalo, presented a terse paper on "The Repair Shop," describing a practical equipment.

This completed the work of the morning and afternoon sessions. At the close of the afternoon session a group portrait was taken. The annual banquet was held in the evening.

WEDNESDAY.

MR. H. H. VREELAND, president of the Metropolitan Traction Company, New York, presented a paper dealing trenchantly with the subject of "Municipal Ownership" and its fallacies.

MR. H. S. COOPER, of Schnectady, N. Y., read a paper on "The Prevention of Accidents; the Best Method To Accomplish This End."

MR. C. L. ALLEN, of Syracuse, N. Y., read a paper on "Low Joints; How To Prevent Them."

MR. F. D. RUSSELL, of Rochester, N. Y., read a paper entitled, "Street Car Wheels; Should They Be Made Heavier?"

The election for officers for 1897 resulted as follows: G. Tracy Rogers (re-elected), president; W. Caryl Ely (re-elected), first vice president; J. T. Nicholls, second vice president; secretary and treasurer (re-elected), Henry A. Robinson. The executive committee: Messrs. H. H. Vreeland, J. W. McNamara, H. M. Watson, C. L. Rossiter.

MR. J. P. CLARK secured the carrying of a resolution for the appointment of a committee of five to co-operate with the Railroad Commissioners of the State in framing uniform, standard rules to govern the operation of street railroads in the State. The committee appointed was H. H. Vreeland, C. L. Rossiter, A. L. Johnson, H. H. Littell and J. W. McNamara.

The 1898 meeting will be held in Brooklyn.

CONVENTION NOTES.

THE TOASTS at the Street Railway banquet at the International on Tuesday night were as follows: Toastmaster, Hon. W. Caryl Ely. Welcome, Hon. Arthur C. Hastings; "The Empire State," Hon. James M. E. O'Grady; "The Niagara of To-day," Hon. Thomas V. Welch; "Street Railroads From the Consumers' Standpoint," John Kendrick Bangs ;"Our Hosts," Hon. Edmund O'Connor; "The Railroad Commissioners," Ashley W. Cole; "Our Transatlantic Visitors," William Murphy, M. P., and J. B. Concannon; "The Association," John W. McNamara; "The Railway Press," J. H. McGraw; "The Ladies," J. H. Stedman; "The Supply Men of To-day," W. J. Clark.

Mr. John M. Brinker was also called upon to make remarks.

THE CENTRAL ELECTRIC COMPANY made a good display of their electric railway specialties and supplies by means of samples, specimen boards, etc.

THE OKONITE COMPANY was represented by Mr. Geo. T. Manson.

MR. ELMER P. MORRIS was present in the interest of the McGuire trucks, Garton-Daniels lighting arresters, Hemingray glass, Monarch paint, Simonds gears and pinions, Point Marion Company's arms; brackets and pinions and Keystone instruments.

AS NOTED in the list of names, there was a good representation of leading supply firms and men, but none of the ex-

hibits were large, and in most cases no attempt was made at an exhibit.

SEVERAL EXCURSIONS to points of interest in and around the Falls were indulged in on Wednesday and Thursday after the serious work of the convention had been disposed of.

FIRE AND POLICE SUPERINTENDENTS' MEETING.

IN accordance with the arrangements made, the International Association of Fire and Police Telegraph Superintendents held their meeting at Nashville, Tenn., at the Maxwell House, on September 14 and 15. This was the second annual meeting of the young society. Papers were presented by Messrs. Brophy and Ayden. An address was delivered by President Frank C. Mason, of Brooklyn, N. Y., in which he stated that the membership was larger than ever and that the association was in good financial condition. He commended the study of modern electrical conditions to the members and praised the efforts of the electro-technical press in disseminating information. The association, he said, was here to stay and would long continue its career of usefulness.

The programme outside the regular meetings and exercises included visits to the excellent Centennial Exposition, an excursion to the famous Belle Mead race horse breeding establishment, and a trip to the summit of Lookout Mountain.

OBITUARY

GEORGE STEWART HEGEMAN.

It is with extreme regret that we announce the death of Mr. George Stewart Hegeman, vice-president of The Hart & Hegeman Manufacturing Company, of Hartford, Conn., who died suddenly at Detroit on Tuesday, September 7, of acute inflammation of the kidneys. Mr. Hegeman left Hartford on August 28 in excellent health, to go to Seattle, Wash., via Montreal. He was taken ill while at Detroit, where he had stopped to visit his sister. His illness lasted less than three days.

Mr. Hegeman was a graduate of the Sheffield Scientific School of Yale College, class of '78, and also of Columbia University Law School. His connection with the company of which he was vice-president, dated from its organization in 1890, and the success of the company has been largely due to his efforts during the first years of its existence. For the past few years he had spent his time in travel, and in looking after his personal interests. Mr. Hegeman was forty years of age and unmarried. His loss will be keenly felt not only by his business associates, but by a large circle of warm friends. The funeral was held at Passaic, N. J., from the home of his parents on Friday, September 10.

LEGAL NOTES

THE CAR HEATER DECISION.

We have received the following communication from Mr. James I. Ayer, general manager of the American Electric Heating Corporation:

The recent decision on car heaters against the West End Street Railway, Boston, refers to some heaters furnished two years ago by the old organization of the American Electric Heating Corporation, similar to those made by another company, but totally unlike the American Company's regular car heater, which was in no way involved in the suit. The suit will be appealed as is usual. The patents under which the American Company's heaters are made fully protect them and the users of them, and have never been called into question, and the American Company report a record of complete satisfaction.

HARTFORD, CONN.—The power plant of the Hartford Electric Light Company on the Farmington River was destroyed by fire last week. This plant furnished a large amount of current for use in Hartford and included two 800 h. p. generators. The loss is put at $70,000. The company will fall back for the present on its old steam plants in Hartford.

EDUCATIONAL

Y. M. C. A. STUDIES IN ELECTRICITY.

The Twenty-third Street Branch of the Y. M. C. A. will open its winter course of electricity the first week in October. It will again be in charge of Mr. Max Osterberg, E. E., A. M., who has lectured there for several years. This year the course will be extended considerably, being divided into two distinct sections, one elementary course starting with the principles of electricity and one advanced course intended principally for stationary engineers, wiremen, electrical workers, in which the engineering principles of lighting, railway and power transmission will be discussed.

Mr. Osterberg will visit a number of interesting installations with his students, to give them object lessons of actual practice. It is also intended to open a course in physics and mechanics if a sufficient number of applicants can be secured. Applicants can get detailed information by applying to Mr. Cox, educational secretary of the branch, 52 East Twenty-third street.

THE STOCK MARKET

A CONSTANT IMPROVEMENT.

There is scarcely any room for doubt that the long heralded tide of prosperity is on the permanent rise. With the continued advance in wheat has come an increased demand for iron, that unfailing sign of activity in all branches. Added to this is the marked increase in railway earnings, notably that of St. Paul, while the truly remarkable increase in bank clearings shows that business men and capitalists are no longer holding back, but are beginning to utilize capital, confident of the stability of the present market.

Electrical securities have shown marked strength during the week past. American Bell continues on its phenomenal upward course, having sold up to 279, with 280 asked, and very little to be had at that figure. There are some that expect to see the stock touch 300 before long. Western Union rose to 96¾, with sales of 62,396 shares for the week. General Electric reached 39, closing at 38½, with sales of 18,407 shares.

REPORTS OF COMPANIES

OUTPUT OF BELL TELEPHONES.

For the month ending August 20 the American Bell Telephone Company increased number of instruments in licensee's hands under rental by 5,613, making this far in 1897 a net gain of 81,544, by far the best August and eight months' exhibit on record. Figures follow:

August—	1897.	1896.	1895.	1894.
Gross output	15,767	9,675	11,009	5,689
Returned	10,154	7,850	8,730	6,531
Net output	5,613	1,825	2,279	*842
December 21 to August 20—				
Gross output	143,545	136,353	109,905	53,144
Returned	62,001	61,517	55,851	46,984
Net output	81,544	74,836	54,054	6,160
Total outstanding August 20	853,833	822,823	679,514	581,163

*Net loss or decrease in telephones under rental.

NEW YORK EDISON COMPANY'S EARNINGS.

The following gives the figures for last month's business of the Edison Electric Illuminating Company:

	August. 1897.	August. 1896.	Increase.
Gross	$170,347.66	$155,010.91	$15,330.75
Net	66,222.59	54,379.31	11,843.28
Gross, 8 months	$1,561,567.45	$1,417,812.87	$143,754.58
Net, 8 months	696,971.61	596,182.86	100,788.75

TRADE NOTES & NOVELTIES

INCREASE IN THE C & C ELECTRIC COMPANYS' GROWTH.

In order to properly care for the large growth in their business, which the C & C Electric Company are now experiencing, they are not only daily increasing their factory force and capacity, but are increasing their office and selling force as well.

Among the late acquisitions to their selling force is Mr. S. L. Nicholson, who is to look after machinery sales in Greater New York and vicinity, under the supervision of their sales manager, Mr. Campbell Scott. Mr. Nicholson will bring to the assistance of the C & C Company a thorough experience in the electrical business extending over ten or eleven years. His experience has been gained with the old Sprague Motor Company, the Wenstrom Company, the Short Company and several others of equal note, besides, more recently, with the Cutter Electric Manufacturing Company, of Philadelphia. In Mr. Nicholson the C & C Company feel that they have made a valuable acquisition to their force, both on account of his experience in selling and installing electrical apparatus, and his high standing as a gentleman.

OVERLOADED IRON CLAD RHEOSTATS.

The Iron Clad Rheostat Company reports an interesting case of overload on one of their rheostats. In experimenting with some special resistance wire, they made up one of their regular plates 8 inches by 8 inches by 1½ inches, having a surface area of 243 square inches, with 2 ohms resistance in the winding. This plate was laid flat on a table, and a current of 22 amperes forced through it for 20 minutes. The current was then increased to 28 amperes for 10 minutes more, and then forced up to 33 amperes. The entire plate soon began to glow with a bright red heat, yet continued to carry the above current for over 20 minutes before burning out, which it did in the most quiet manner possible, the only visible action being a bright red spot moving about the plate as the arc burnt its way from one part to another. This process alone occupied over one minute, and there was entire absence of the usual pyrotechnic display, incident to a "burn out" on heavy current. During these last 20 minutes the plate was dissipating approximately 2,700 watts, more than ten times its rated capacity.

ANOTHER SALE OF APPARATUS FOR ENGLAND.

The Westinghouse Electric and Manufacturing Company has received from its European company notice of the award to it by the Metropolitan Electrical Supply Company of the contract for a large electric lighting plant to be installed in London. The apparatus will be of the multiphase type, involving the use of the Tesla patents, which are owned in England by the Westinghouse Company. It is understood that the contract amounts to between $350,000 and $400,000.

ARMORITE IN NEW YORK.

MR. R. B. COREY, 711 Havemeyer Building, New York, has been appointed by the Armorite Interior Conduit Company to take charge of the metropolitan district, in the interests of Armorite conduit. This conduit has recently been passed by the National Board of Fire Underwriters and the Fire Department of the city of New York, and it is Mr. Corey's intention to carry a large stock in this city, so that all orders for this vicinity may be filled promptly. The demand for Armorite is steadily increasing, and with first class facilities for manufacture at Pittsburg the Armorite Company are in good condition to fill all orders, however large, expeditiously.

ADVERTISERS' HINTS

THE NEW YORK TELEPHONE COMPANY, in calling attention to the convenience of their service, state that there are 19,500 telephone stations in this city alone.

THE MIANUS ELECTRIC COMPANY, Mianus, Conn., advertise telephone and electrical supplies. Their stock is at all times large and replete.

THE D. & W. FUSE COMPANY, Providence, R. I., claim to be making the "Only" non-arcing fuse on the market for switchboards, transformers, motors, etc. It has been approved by the National Board of Underwriters.

EDWARDS & CO., 144th street and Fourth avenue, New York, have recently brought out a Ruhmkorff coil guaranteed to work on high or low potential. They also advertise the "Eco" bells and buzzers with no adjustments to be displaced. The buzzers are made in five sizes and the bells with 1 inch to 5 inch gauge.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., illustrate the machine shop built by them for the Ball & Wood Company, at Elizabethport, N. J.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., draw notice to their standard portable direct-reading instruments. Their price lists 8 and 9 describe them fully.

F. A. BAUX, Chamber of Commerce Building, Chicago, Ill., offers some special bargains, multipolar generators and motors, incandescent lighting machines, switchboards, switches, etc.

WILLIAM D. MARKS, 901 Montgomery avenue, Philadelphia, Pa., may be consulted on all matters related to electrical or mechanical engineering. His specialty is the reorganization of finances and machinery of unprofitable electrical enterprises.

KIELEY & MUELLER, 17 West Thirteenth street, New York, advertise the Kieley steam trap, pressure regulators and damper regulators, especially adapted for electric and high pressure plants.

THE GENERAL ELECTRIC COMPANY recommend their inclined-coil, portable, alternating current instruments as indispensable to station managers. The advantages claimed for them are permanency, accuracy under all conditions, high grade and low price.

THE STIRLING COMPANY, Chicago, Ill., refer to a remarkable physical test of their boilers, described on another page in this issue.

THE BALL ENGINE COMPANY, Erie, Pa., illustrate the evolution in governing devices since 1883. This includes an illustration of their August, 1897, governors.

THE INTERIOR CONDUIT AND INSULATION COMPANY, 527 West Thirty-fourth street, New York, say the broad fundamental patents covering their process of manufacture prevent even an approach to the features wherein lie the strength and integrity of insulation possessed by their standard iron-armored insulating conduit.

WESTERN NOTES

ELECTRIC APPLIANCE COMPANY, Chicago, are well pleased with their experiment of carrying in stock in Chicago a line of porcelain in all styles and sizes of knobs and tubes, that would enable them to fill any order. The advantage of having this stock in Chicago, instead of having to go to the factories for this material, seems to be appreciated by the trade, and the Electric Appliance Company are reaping very satisfactory results. They are the Chicago depot for one of the largest porcelain works in the country, and a customer's requirements must be very severe, indeed, which cannot be satisfied directly from the Electric Appliance Company's stock.

THE WESTERN ELECTRIC COMPANY'S non-sparking brush, which is manufactured under patents controlled exclusively by that company, is being extensively advertised and pushed and is meeting with satisfactory results.

ADAMS—BAGNALL ELECTRIC COMPANY, Cleveland, Ohio, have recently installed 300 series-burning enclosed arc lights for the Lowell Electric Lighting Corporation, Lowell, Mass., for lighting the streets of the city.

WALKER COMPANY, of Cleveland, Ohio, have just issued an interesting circular, No. 1049, on "How to Select a Dynamo," which enters into and illustrates the various points that deserve study in purchasing generators for any class of work.

WILLARD ELECTRIC AND BATTERY COMPANY, of Cleveland, O., have received an order from the Riker Electric Motor Company, of Brooklyn, for several storage batteries to be used in operating motor carriages. These batteries have a capacity of 40 amperes per 30 ounces of active material in the positive plate, and a total capacity of 65 ampere hours. The Willard batteries have been selected, it is said, because of being the lightest batteries for their capacity that are now placed on the market.

WILLIAMS & ABBOTT CO., of Cleveland, O., report an unprecedented demand for their magneto bells for telephone work, necessitating a night shift of men. The outlook continues excellent.

THE UPTON LONG BURNING MIDGET LAMP in its original form, adapted to burn singly on 110 volts, has proven to be such a success that several modifications of it have been designed, including the Midget long burning lamp to burn two in series on 220 volts, a Midget lamp to burn five in series on 500 to 550 volts, and a Midget high tension series lamp to burn on series arc circuits of from 4½ to 7 amperes. All of these lamps are giving remarkable results, and having a very large sale. The Midget Upton Lamp is one of the Electric Appliance Company's specialties, and they are pushing it with their usual energy.

NEW YORK NOTES.

NEW YORK TRAVEL.—The volume of passenger traffic, surface and elevated, is increasing in much more rapid ratio than the population. In 1890 the total number of passengers carried within the city limits was 406,000,000. In 1894 it was 448,000,000. In 1895 the aggregate had reached 469,000,000, and last year it was 526,000,000, an increase of 57,000,000 passengers in a single year. The projected tunnel scheme now before the special rapid transit commission, is figured to take care of 200,000,000 more per annum.

CHESLEY ELECTRIC COMPANY, W. S. Chesley president, have removed their main office from their Hoboken factory to the Havemeyer Building, New York City, where they have taken larger quarters. They have a large stock of second-hand dynamos and engines and have made a good many sales recently. They are also very busy on repair work.

PHILADELPHIA NOTES

STANDARD UNDERGROUND CABLE CO. have opened an office in Rooms 1225 and 1226 Betz Building, Philadelphia, with long distance telephone connection between the office and the Pittsburg factory. This new branch has been placed in charge of Mr. T. E. Hughes, formerly manager of their wire department in New York City.

PHILADELPHIA GAS IMPROVEMENT COMPANY, of Philadelphia, Pa., are increasing their plant by erecting a new fireproof pipe shop, constructed entirely of iron. The building has steel framework and a corrugated iron covering. Contract for erecting the building has been let to the Berlin Iron Bridge Company, of East Berlin, Conn.

ELMER G. WILLYOUNG & COMPANY report a bad fire at 904-6 Nassau street, Philadelphia, occupied by them as a branch shop, where they have also drafting rooms, photograph rooms, glass shop and an experimental laboratory. The place was used principally for the manufacture of induction coils and X-ray apparatus. Loss, $3,000; insurance, $2,500. New quarters have been secured, and all orders are being filled with no delay.

NEW ENGLAND NOTES

PROVIDENCE, R. I.—The Union Railroad Company has awarded a contract for fender equipments for 250 cars to the Parmenter Fender Company, of Cambridgeport, Mass. It is a counterbalanced device, with tripping arrangement, and is automatic, imposing no extra duty on the motorman. The contract calls in all for 500 fenders.

BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., have the contract for the new boiler house which the New York Belting and Packing Company are putting up at Passaic, N. J. The building will be entirely fireproof, brick walls, with steel roof trusses covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron covering.

MR. C. S. KNOWLES, 7 Arch street, Boston, and 120 Broadway, New York, has issued a very neat and informational circular in regard to his Imperial porcelain, made by the Duggan Imperial Porcelain Works, at Trenton, N. J.

WEST END RAILWAY.—A lease of this great trolley system to the Boston Elevated Railroad Company is proposed, with 8 per cent. dividends guaranteed.

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Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. SEPTEMBER 23, 1897. No. 490.

TELEPHONY AND TELEGRAPHY

THE BINGHAMTON, N. Y. TELEPHONE EXCHANGE.

BY HARRY A. GARDNER.

BINGHAMTON, N. Y., because of its beautiful location and the attractiveness of its streets and buildings, has long been known as the "Parlor City." The same enterprise that has given it a beautiful appearance has always been manifested in the early introduction into that city of the great electrical improvements that have marked the closing quarter of the nineteenth century. Within a year of the time that Frank J. Sprague equipped his first electric railroad in Richmond, Va., the horses of Binghamton were shying at the whizzing "broomstick train"; her streets were illuminated with the brilliant arc in the early eighties; and she was among the first to feel the benefits of the distance annihilating invention of Prof. Bell.

The New York and Pennsylvania Telephone and Telegraph

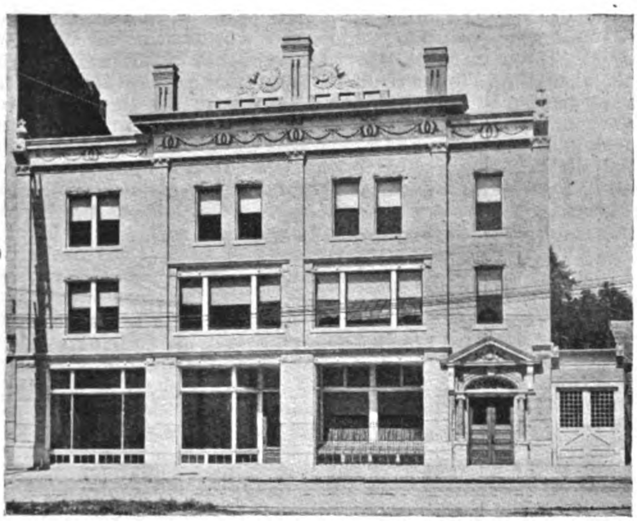


FIG. 1.—BINGHAMTON TELEPHONE EXCHANGE BUILDING.

Company has always been one of the successful branches of the Bell system; and it introduced exchanges in Binghamton, Elmira and other southern New York and northern Pennsylvania towns in the early days of telephony. During the past year this company has been making improvements in Binghamton which give that city as good a service and as finely equipped an exchange as can be found in the country.

Something over a year ago a franchise was obtained from the authorities for the construction of a subway through most of the important streets of the city. The prepared wooden conduit of the Wycoff Wooden Pipe Company, of Williamsport, Pa., was the conduit decided upon. These ducts were placed in the streets last summer, but the work of drawing in the cables was not begun until early this spring. According to the requirements of the franchise, a subway capacity double the present needs of the company was installed.

Since the telephone system was first introduced into the city, the exchange had been located upon the top floor of an office building on the principal business street of the city. With the aerial service no more convenient location could have been selected. But with the determination to introduce an underground system, the managers found what had heretofore been convenience transformed into decided inconvenience. Their requirements had outgrown the former office, and when the question of leading underground cables up through a building that had not been prepared for it, came up, the tearing out that would accompany such a course determined them to seek new quarters. With an underground system established, moreover, they wished to decide upon a permanent location.

Arrangements were finally made whereby a new building was to be erected for their express purpose. This building is

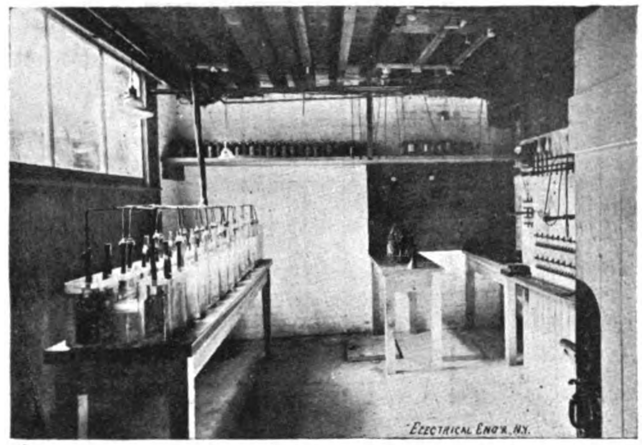


FIG. 2.—BATTERY ROOM AND REPAIR SHOP, BINGHAMTON.

on State street, about two blocks from their former location. It has recently been completed, and the company moved into its new quarters the 7th of July.

The new building, Fig. 1, is peculiar in that the depth is only 20 feet, while it has a frontage of 76 feet. The entire basement, second floor and half of the first floor are devoted to the use of the telephone company. In the basement is a repair shop and battery room, Fig. 2, containing the batteries, the motor-dynamo for charging them, the battery and power switchboard, distributing switch for the electric lights, etc. The business office is located on the first floor. The manager's private office opens out of the business office, as do two sound proof telephone booths. The operating room, testing room and operators' toilet and lunch rooms are located upon the second floor.

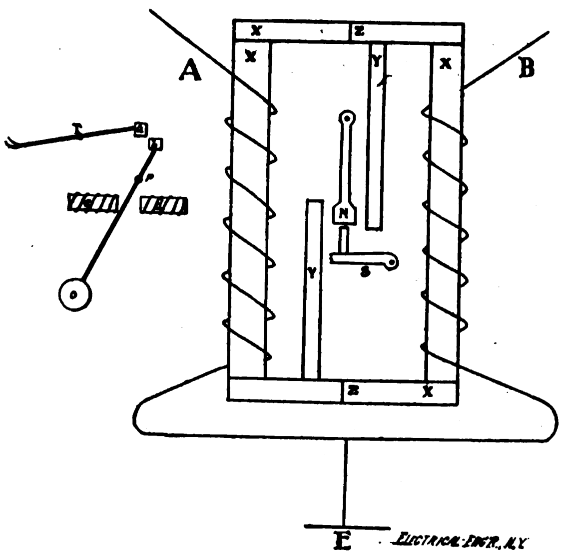
In the equipment of this exchange every detail has been carefully worked out by the efficient electrician of the company, Mr. B. C. Wolverton. Not a superfluous wire or contact has been used, and not a thing left out that could add to the efficiency of the service. A simple switchboard, shown in Fig. 3, consisting of twelve 50-drop panels, was installed, because it was thought that fully as satisfactory a service could thus be secured without the multiplicity of wires, contacts, etc., of a multiple board. Various time-saving devices have

FIG. 3.—THE OPERATING ROOM, BINGHAMTON TELEPHONE EXCHANGE.

been introduced, so that a subscriber can be served with fully as much dispatch and few more movements on the part of the operators than would be required with a multiple board.

In the first place, all telephones will be equipped with a device, doing away with the crank-turned magneto bell, which

is much more simple than anything of the kind heretofore put in general use. This will be accomplished by substituting batteries for magnetos in making calls. One side of the circuit will be grounded at the exchange, and a ground wire will be attached to each telephone in service, which will be so arranged that when a subscriber removes his receiver from the hook, the hook, in rising, makes a momentary contact with the ground, thus closing the circuit through the ground and one side of the line; the momentary current actuates the shutter magnet at the exchange and causes the shutter to open. As the operator inserts the plug in the spring jack to answer



FIGS. 4 AND 5.—MECHANISM OF INDIVIDUAL CALL.

the call, she automatically closes the shutter again. When the subscriber hangs up his receiver after he is done talking, pulling down the hook thereby, another momentary contact with the ground again opens a "clearing out" shutter, thus compelling the subscriber to "ring off" whether he forgets it or not.

Another device does away with much of the talking between the operators at different tables, which was necessary when making connections between panels under the old system. If an operator wishes to connect a subscriber with a number at another panel, she inserts the plug which is already connected with the calling subscriber, in the spring jack which connects with the other panel, at the same time, with a little switch, throwing her telephone in connection with the transmitter of the operator at the other table. The insertion of the plug in the jack lights a tiny lamp at each table, thus notifying the second operator that a number on her board is wanted. This lamp also acts as a guide to tell her in just what spring jack to insert one end of the cord, and as soon as she gets the number required, she can complete the connection with the single motion of inserting one plug in the proper jack; and as she inserts that plug, it extinguishes both lamps, notifying the first operator that the connection is made. When either operator commences to "clear out," the removal of the plug lights

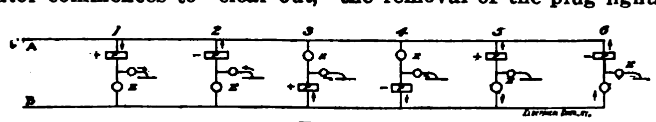


FIG. 6.

the lamps, notifying the other operator that the clearing out has commenced, and as the second operator clears out, the lamps are extinguished, thus announcing that the operation is completed. Thus is obviated all talking between tables, except merely the telling what number is required. The signal lamps used are about ¼ inch in diameter, and are operated by a 4 volt circuit.

Each panel of the board contains a switch, so that if desired the panels can be thrown together in sets of two each; or the panels of any set may be connected and the rest left single. Each set can thus be operated by a single operator. A two-panel multiple board for the long distance or toll lines is placed at one end of the room. The same arrangement of signal lights exists between this board and the city boards.

The chief operator's desk is connected with each panel of the switchboard. In case of trouble on the line, or workmen who are out making repairs calling up, all responsibility is turned over to the chief operator by connecting her with the line in question. She is also able to throw her instrument into connection with the transmitter of any operator at any time, thus being able to keep watch to see that no unnecessary conversation is being carried on.

Another novel feature consists in the flexible cord of the head telephone of each girl being connected to switchboard by means of a plug, instead of being fastened there. When a girl leaves a table, instead of throwing down her instrument, she simply removes the plug and takes it with her. When leaving the building she places it in her locker in the toilet room. The principal object of this is to disconnect the transmitters from the circuit, so that they are not consuming current, except while in use.

While the small generators in the basement are depended on for making all calls, each board is supplied with a hand generator, which can be thrown in by a switch, if, for any reason, the generator cannot be used.

One panel of the switchboard is fitted up for a "selective call" board, to which lines serving more than one subscriber can be brought. It is possible with the system used to place six subscribers on a line. This board is at present wired for twenty lines. The disagreeable feature of a party line, of having some one else ring up or listen while a person is talking, is obviated by this novel improvement. By the use of differentially wound magnets and polarized relays upon the instruments, through which current can be sent in either direction, either through the ground or the two wires of the line, it is possible to work different combinations for calling up any one of the six subscribers wanted and at the same time lock out all the other instruments on that line.

The receiver hook lever of each instrument, which turns on the pivot, r, Fig. 4, has upon the other end a shoulder, a, which, in the normal condition when not in use, is in the position shown. Upon another pivot, p, another lever turns. This lever has upon one end the shoulder, b, and at the other the small disc, o, upon which the words "line in use" are printed. When a subscriber removes his receiver from the hook, throwing his instrument into service, the shoulder, a, lowers, passes by the shoulder, b, and makes it impossible for the second lever to be operated. Every instrument on the line contains a locking magnet, d, and an unlocking magnet, e, which attracts the locking lever either to the right or left, according to which magnet is energized. The same combination of current actuates the magnet, d, in every one of the instruments, and sending the current in another certain manner actuates the magnet, e, in every case.

When any one of the subscribers on the line calls up, the first thing the operator does, before she answers even, is to press a button that sends a current in the proper manner to actuate the locking mechanism of every instrument on that line, except the one calling. She then makes the necessary connections, and the conversation can proceed without fear of interruption or listening on the part of any one else on the line.

When "central" clears out, she presses the unlocking button and sends the current over the line in such a manner that the locks of all the instruments are opened, the levers drawn back to the normal position, and the line is again clear for any one.

When it is desired to call any subscriber, "central" first locks every instrument on the line; then by sending the current in the right direction, the armature of a relay in the instrument of the subscriber wanted is actuated. This armature completes the circuit of the local battery of this instrument and rings the bell, and at the same time actuates another relay which sends current through the unlocking magnet of that instrument only, thus making it possible for this particular subscriber to answer while all the others on the line are still locked out. At the conclusion of the conversation all of the instruments are unlocked and the line is open for every one.

This gives a general idea of the operation of these instruments, but the principle is better shown in Fig. 5.

In Fig. 5, which shows the locking and unlocking device, X X X X are iron strips forming a closed magnetic circuit, Y Y are iron pole extensions, and n a permanent magnet. When the current enters a and b, going to coils and to earth, consequent poles are set up at Z Z, and Y Y are magnetized, one N and one S and n is pulled one way. When current enters at e and goes out at a and b, the action is reversed. S is the hook and n either allows it to move up or prevents it.

In Fig. 6, which shows the manner in which sending the current in different directions operates different instruments, P in each instrument is a polarized relay and E in each case is a neutral relay. Both relays at a station must be closed at the same time to call that station. The neutral relays are closed when no current is passing and the polarized ones are open when no current is passing. Then to call No. 1 connections are so made that the positive pole of the battery con-

nects with line, A; no current goes to line, B, and the negative pole is grounded. Current then flows as shown by arrows in No. 1, closes the polar relay, P, in 1, neutral relay, E, remains closed and the bell rings. The negative relays at 2 and 6 and neutral relay at 5 are open, as are relays, P, in 3 and 4, through which no current has passed. To operate No. 2 the positive pole of battery goes to ground, no current to B, and negative pole to A. The relays, P, at 1, E at 3 and 4, and P at 5, and E at 6, are open, but the negative relay, P, at 2 closes, and no current passing E at 2, it remains closed and the bell rings.

To operate No. 3 the positive pole of battery goes to B, nothing to A, and negative to ground. Relay, P, at 3 closes, neutral remains closed and bell rings, while E at 1, 2, 5 and 6, and P at 4 are open. No. 4 is called by sending positive to ground, negative to B and nothing to A, when P and E at 4 are both closed, while E at 1, 2, 5 and 6, and P at 3 remain open. For No. 5 the positive goes to A and negative to B with nothing to ground, and for No. 6 the positive is sent to B and negative to A.

Current for the switchboard signal lamps and the exchange transmitters is furnished by three Chloride accumulators, rated at a normal discharge of 30 amperes. By an ingeniously arranged switchboard these batteries are so connected that either one or two can be charged while the other two or one are discharging, or all can be charged or discharged at once. As used two are continually discharging while the other one is being charged. The charging is done from a Western Electric motor-generator, which takes current from the 500 volt power circuit of the Binghamton General Electric Company, and transforms it to 6 volts or less.

Current for calling subscribers on the selective call system from central is taken from a series of thirteen storage cells with a rated discharging capacity of 15 amperes. There are two series of these cells, one set being charged while the other is discharging. The subscribers of this system call central by the use of 75 Mesco dry cells. On the ordinary circuits "central" calls subscribers with current from small generators placed in the basement and operated by a small water motor, and the subscribers are aided in calling the exchange by 25 cells of dry battery.

The novel arrangement of many old and some new features in the equipment of this plant has attracted the attention of telephone experts of much larger cities, and the commendation of electricians who have examined the exchange give Messrs. W. N. Easterbrook and E. B. Rogers, of Elmira, the general manager and district superintendent of the company, and W. J. Garvey, of Binghamton, the local manager, a right to be proud of this exchange and to believe that it is one of the finest, for its size, in the country.

DISTURBANCE OF SUBMARINE CABLES BY ELECTRIC RAILWAYS.

The disturbance of submarine cable working by electric tramways forms the subject of a paper by Mr. A. P. Trotter in the Journal of the Institution of Electrical Engineers. As soon as the electric tramway service was started at Cape Town the working of the syphon recorder of the submarine cable of the Eastern and South African Telegraph Company was found to be seriously affected. When the tramcars were started and when they were stopped, "kicks" were recorded by the syphon recorder, and these being superimposed upon the received signals made it difficult and often impossible to read the message. The first mile of the cable was at a mean distance of about half a mile from the tramway. After a long series of experiments Mr. Trotter found that the only way to cancel the disturbances was to lay a new cable of about five miles long, as nearly as possible over the old one, the cable terminating in an earth plate. As soon as this had been done the traffic was resumed, and no appreciable disturbances of the recorder took place. In the discussion upon the paper Mr. W. H. Preece said that similar disturbances occurred wherever electrical tramways and telegraphs, submarine or overland, existed together. Prof. Ayrton gave an account of observations of magnetic disturbances over the whole neighborhood of the City and South London Electric Railway, which runs underground between London Bridge and Stockwell. The suspended magnet used in the investigation showed that disturbances of the earth's magnetic field occurred throughout the whole region of the line, and were caused either by magnets or masses of iron in the passing trains, or by currents passing through the earth.

NEW YORK CITY is now talking to Council Bluffs over the long distance telephone circuits, connections having been completed last week. Omaha was also put in circuit.

A DECADE OF ELECTRIC RAILWAY DEVELOPMENT.[1]

BY W. J. CLARK.

AN eminent writer on railway subjects has substantially said that a railway is a "machine for the manufacture of transportation."

Were we asked, in a single instance, to cover the full meaning of this paper's title, we might respond with such a quotation, for, most certainly, viewing the true objects of a Transportation Company in the broadest manner possible, it is to exemplify this theory, and probably in the whole history of transportation, no class of managers has done so much to create travel rather than to merely take care of what may seem to be the existing demand, as have those of American street railways, since they have had at their command that most

TABLE I.

GENERAL COMPARATIVE STATEMENT OF STREET RAILWAYS IN THE UNITED STATES, JANUARY 1, 1888, TO JANUARY 1, 1897.

	1888.	1897.
Total number of operating companies...	615	806
Number of street railway systems operated by horses	566	167
Number of street railway systems operated by cable	18	38
Number of street railway systems operated by steam dummies (not including elevated)	35	33
Number of street railway systems operated by electricity	21	698
Mileage of horse car track	5,474	1,010
Mileage of cable track	217	515
Mileage of steam dummy track (not including elevated)	216	145
Mileage of electric track	86	13,580
Total mileage of street car tracks...	5,993	15,250
Number of horse cars	21,736	3,664
Number of cable cars—grip, 860; trail, 1,917	2,777	5,957
Number of steam dummies and cars—dummies, 165; cars, 258	423	318
Number of electric motor cars, 166; trail cars, 6	172	37,097
Tot. No. of street cars, all descr'pt's.	25,108	47,036
Percent. horse car track to tot. mileage.	.914	.066
Percent. cable track to total mileage...	.036	.034
Percent. dummy track to total mileage..	.036	.009
Percent. electric track to total mileage..	.014	.891
Percent. horse cars to total number....	.866	.078
Percent. cable cars to total number....	.111	.127
Percent. dummy cars to total number..	.017	.007
Percent. electric cars to total number...	.006	.788
Ave. length horse car systems....miles	9.67	6.05
Ave. length cable systems........miles	12.06	13.55
Ave. length dummy systems......miles	6.17	4.39
Ave. length electric systems......miles	4.09	18.02
Largest street railway system (West End Company, Boston) operated by horses ....miles	212	430
Largest cable system (that of Chicago City Railway Company) ....miles	26.25	....
Largest electric street railway system (Richmond Union Passenger Railway, 40 cars) ....miles	13	Union Trac. Co. Phila.

flexible of transportation agents—electricity. In carrying out this broad-gauged policy, they have benefitted communities and the general public to an extent that is beyond any estimate that can be placed upon the same, and, while it is true certain benefits have accrued to their stockholders, these do

[1]Read before the N. Y. State Street R'way Assoc., Niagara Falls.

TABLE --.

COMPARATIVE GENERAL STATISTICS ON ALL OPERATING RAILWAY COMPANIES NEW YORK STATE, 1887-1896.

SURFACE STEAM ROADS.

	1887.	1896.	Inc. or Dec.	Per Cent. Inc. or Dec.
Gross earnings freight and passenger traffic	$143,724,490.62	$210,089,592.75	$66,365,102.13	46.09
Operating expense freight and passenger traffic	51,284,516.02	64,026,174.98	12,741,658.96	24.87
Net earnings from operation	92,439,974.60	146,063,417.17	53,523,442.57	57.98
Income from other sources	5,453,671.31	7,132,210.88	1,673,539.57	30.80
Gross income from all sources	56,738,187.33	71,158,385.86	14,420,198.53	25.90
Interest	17,469,522.21	23,052,019.30	5,582,497.09	32.00
Rentals of leased lines	14,702,117.28	20,710,892.89	6,008,775.61	40.80
Taxes	5,018,907.21	7,781,389.32	2,762,482.11	55.01
Miscellaneous deductions from gross income	1,039,697.49	1,390,260.29	350,562.80	33.72
Total deductions from gross income	38,230,244.19	52,934,561.80	14,704,317.61	52.20
Net income from all sources	18,507,943.14	18,223,824.06	284,119.08	1.53[1]
Dividends	10,207,885.50	14,557,454.00	4,349,568.50	42.12
Miscellaneous payments from net income	15,654.04	102,554.13	86,900.00	555.10[1]
Surplus	8,284,403.60	3,563,815.93	4,720,587.67	87.00
Percentage operating expenses to gross receipts	64.42	69.52	5.1	7.92
Percentage net income to capital stock	3.5	2.43	1.07	30.6 [1]
Percentage dividends to capital stock	2.19	2.49	.3	13.7
Percentage gross income to cost road and equipment	4.81	5.39	5.8	12.07
Total passengers carried	94,272,116	179,315,449	83,043,333	90.25
*Passenger earnings per mile traveled	2.36	2.22	.01	5.94[1]
*Passenger expense per mile traveled	1.51	1.64	.13	8.61
*Passenger profits per mile traveled	.85	.58	.27	31.73[1]
Miles of track in New York State	12,248.44	14,401.25	2,152.81	17.57
Gross earnings from operation per mile of road operated	12,090.03	13,787.21	1,697.18	14.04
Operating expense per mile of road operated	7,776.00	9,585.47	1,809.47	23.32
Net earnings from operation per mile of road operated	4,314.03	4,201.74	112.29	2.61[1]
Average number of employés for year	102,634	146,987	443.53	43.22
Combined net income of operating companies and dividends of leased companies, constituting entire net income of all roads	22,122,931.74	22,337,604.59	214.662.85	.97

ELEVATED STEAM ROADS.

	1887.	1896.	Inc. or Dec.	Per Cent. Inc. or Dec.
Gross earnings, freight and passenger traffic	$8,691,439.49	$11,896,461.45	$3,205,021.96	36.87
Operating expense freight and passenger traffic	4,962,148.96	7,154,581.22	2,192,332.26	44.20
Net earnings from operation	3,729,290.53	4,741,880.23	1,012,589.70	27.18
Income from other sources	87,659.06	247,119.87	159,460.81	182.00
Gross income from all sources	3,816,949.59	4,989,000.10	1,172,050.51	30.72
Interest	1,781,442.29	3,104,125.36	1,322,683.07	74.24
Rentals of leased lines	20,000.00	62,225.00	48,225.00	241.1
Taxes	478,294.83	895,830.31	417,535.48	87.40
Total deductions from gross income	2,279,737.12	4,068,180.67	1,788,443.55	78.53
Net income from all sources	1,537,212.47	920,819.43	616,393.04	40.1 [1]
Dividends	1,560,000.00	1,800,000.00	240,000.00	15.38
Surplus	22,787.53	879,180.57	856,393.04	376.5 [1]
Percentage operating expenses to gross receipts	57.08	60.14	3.06	5.36
Percentage net income to capital stock	4.79	1.91	2.88	60.13[1]
Percentage dividends to capital stock	4.9	3.73	1.17	23.90[1]
Percentage gross income to cost road and equipment	7.96	5.02	2.94	36.93[1]
Total passengers carried	172,358,082	235,330,148	62,972.066	36.53
*Passenger earnings per mile traveled	5.04	5.05	.01	.2
*Passenger expense per mile traveled	2.88	3.04	.16	5.56
*Passenger profits per mile traveled	2.16	2.01	.15	6.94[1]
Miles of track in New York State	109.81	167.743	57.933	52.75
Gross earnings from operation per mile of road operated	79,140.69	70,921.73	8,218.96	10.38[1]
Operating expense per mile of road operated	45,103 60	42,652.80	2,450.80	5.45[1]
Net earnings from operation per mile of road operated	34,037.09	28,268.93	5,768.16	16.94[1]
Average number of employés for year	5,136	7,120	1,984	38.66
Combined net income of operating companies and dividends of leased companies, constituting entire net income of all roads	1,537,212.47	920,819.43	616,393.04	40.1

STREET RAILWAYS.

	1887.	1896.	Inc. or Dec.	Per Cent. Inc. or Dec.
Gross earnings, freight and passenger traffic	$17,966,518.31	$28,808,898.84	$10,842,380.53	60.38
Operating expense freight and passenger traffic	13,291,855.32	17,848,759.27	4,556,903.95	34.31
Net earnings from operation	4,674,662.99	10,960,139.57	6,285,486.58	134.6
Income from other sources	320,933.38	1,428,192.86	1,108,259.48	346.4
Gross income from all sources	4,995,596.37	12,388,332.43	7,392,736.06	148.1
Interest	1,565,711.62	3,351,770.31	1,786,058.69	114.15
Rentals of leased lines	342,318.00	3,833,211.91	3,490,893.91	102.0
Taxes	829,192.49	1,164,820.40	335,627.91	40.4
Miscellaneous deductions from gross income	54,747.97	170,993.42	116,245.45	212.6
Total deductions from gross income	2,791,970.08	8,520,796.04	5,728,825.96	205.3
Net income from all sources	2,203,626.29	3,867,536.39	1,663,910.10	75.65
Dividends	1,415,397.50	3,379,953.95	1,964,556.45	113.95
Miscellaneous payments from net income	36,128.76	8,503.73	27,625.03	76.7 [1]
Surplus	152,100.03	479,078.71	273,021.32	36.33
Percentage operating expenses to gross receipts	73.98	61.96	12.02	16.26[1]
Percentage net income to capital stock	6.89	3.61	3.28	47.65[1]
Percentage dividends to capital stock	4.5	5.08	.58	12.89
Percentage gross income to cost road and equipment	8.58	4.8	3.78	44.05[1]
Total passengers carried	361,543,930	672,498,760	310,954,830	86.1
*Passenger earnings per mile traveled	4.97	4.28	.69	13.90[1]
*Passenger expense per mile traveled	3.68	2.65	1.03	28.00[1]
*Passenger profits per mile traveled	1.29	1.63	.34	26.35
Miles of track in New York State	908.91	1,736.99	825.08	91.15
Gross earnings from operation per mile of road operated	19,765.12	16,591.25	3,173.87	16.07[1]
Operating expense per mile of road operated	14,622.49	10,275.60	4,346.80	29.68[1]
Net earnings from operation per mile of road operated	5,142.63	6,325.65	1,183.02	23.05
Average number of employés for year	13,873	23,952	10,079	72.70
Combined net income of operating companies and dividends of leased companies, constituting entire net income of all roads	2,226,974.29	5,774,229.72	3,547,255.43	159.3

*Elevated and steam railways per passenger. [1]Decrease.

not begin to aggregate the blessings that electric traction has conferred upon those who are frequently the most anxious to condemn it as a motive power. It is with this phase of the situation that this paper will deal, rather than elaborating upon the conquests that have been achieved in the technical and engineering branch.

Going back to the commencement of the present decade, there was in your State but one electric line, some three miles in length, and this particular road, although it enjoys the distinction, Mr. President, of being the nucleus around which you have built an extensive and model electric railway system, you will concede was experimental in its character, and that those other small lines which were contemplated at the same period in New York State were of similar experimental character, so that, commercially, electric traction could not be said to have existed in the Empire State ten years ago; yet, at the present moment there are slightly over 6,000 motor cars in daily use within the territory covered by your association. But to grasp the extent and rapidity of electric railway development, the accompanying comparative statement, covering all the street railways in the United States (and never, I believe, given in this form to the public) will best serve as an illustration.

From such statement it should be noted, not only the tremendous increase in percentage of electric traction to the total, approximately 15,000 per cent., but also the fact that the street railway mileage of the United States has increased over 156 per cent. during the period given. During the same interval the mileage of American steam railways has increased but 31 per cent. This fact in itself would seem to demonstrate that the American street railway men have grasped the possibilities of building up transportation in a more thorough manner than have their brethren of the steam railway fraternity, as well as demonstrating the theory which we have advanced. But for a more immediate illustration of the comparative growth, as well as some other startling facts, let us come nearer home and introduce a comparative statement compiled from the reports of the Railroad Commissioners of the State of New York for the years 1887 and 1896, covering street railways, surface steam railways and steam elevated systems. See page 272.

It may be said that all of the wonderful progress above shown by the street railway interests cannot be directly attributable to electricity, as the introduction of cable in New York City is, to a certain extent, responsible for such progress, yet as the effect of the cable traction on our general proposition is so similar to that of electricity, and as New York is so fast becoming an electric traction city, it is considered unnecessary to go into the refinement of sub-division of mechanical traction methods in their effect, for both tend to demonstrate the theory which we have advanced, and show that as great benefits have been conferred upon the community served as can be done consistently with the financial investments, in the corporations, and, unquestionably, to a certain extent, show also that in development which discounts the future, resulting in the public benefit referred to, the interests of stockholders may not have been as thoroughly promoted as if a less liberal policy had been pursued. Yet, some of the figures, unless further explained might be grasped by those who advocate municipal ownership, reduced rates of fare, and additional burdens upon street railway corporations, as demonstrating the theories of increased earnings, reduced operating expenses and other things which they consider sufficient reasons for advocating the practical confiscation of vested rights of the greatest benefactors, in a corporate way, communities have ever had. True, street railway earnings have increased and operating expenses have decreased, and many other advantages have come to the street railway companies through the introduction of electricity, but for every dollar of actual net return which the investor in street railway securities has received in the Empire State, we do not hesitate to say that the municipalities and the general public have received at least $10 direct benefit, and that the general public has thus profited far more greatly from the advantages of rapid transit than have the investors who produced it.

Let us consider some of the figures quoted. In 1896, the operating street railways of New York State paid $1,164,820.40 in direct taxes—a good-sized percentage in itself on gross receipts, as will be noted. This, let it be remembered, does not include certain additional amounts paid by the holders of securities of lessor and other companies or certain percentage contributions, which, if calculated together, would compare favorably in amount with the demands for percentage payments made by some of the loudest advocates of such theories. A little calculation will also show that the street railway companies maintain about 9,000,000 square yards of street surface or paving; the practical equivalent of maintaining a street 250 miles long; yet, as is well known, with the now rare exception of horse railways, the street railways of New York State do not wear the surface of the street at all, but their tracks unquestionably save much wear from vehicle travel, as compared to the ordinary roadway, which must be maintained by the municipality. Remember these burdens are imposed for the privilege of running the "poor man's carriage."

From a calculation based upon the census returns of 1890, the average tax rates of the various cities in New York State, the owner of an ordinary carriage or vehicle pays, proportionately, only about one-sixth as much for his privilege of going where he will with the same and wearing out the pavements at pleasure.

One of the results, for which I presume electricity must be to a certain extent held responsible, owing to the expectation of greater returns and other excuses made by municipal officials, for unreasonable assessment, is inequality of taxation. To illustrate this point, the author has included a somewhat surprising calculation, compiled from the Railroad Commissioners' report for 1896, which would seem to demonstrate that valuation of property, earnings, passengers carried, car miles run, or no other intelligent basis of assessment of taxation on street railways in this State has been followed, and that certain hardships have resulted, is clearly apparent.

But to return to our analysis of the general statistics given, it is to be regretted that the data is not attainable which would show the exact increases in valuations of real estate, caused directly by the extensions of street railway lines during the past ten years. We believe, however, that such increases in New York State amount to $300,000,000, a direct gain to the holders of abutting and adjacent property and a direct benefit to the State and municipalities by increasing the amount of taxable property. This, it will be noted, is more than the entire investment in street railway properties.

Let us make another calculation: It is certainly reasonable to suppose that the extensions of street railway lines, and faster service obtained, during the past ten years, saves to each passenger at least ten minutes of time. This means annually to the citizens of New York State, a saving of 112,083,127 hours. Consider such time to be worth only an average of as low as 10 cents per hour, and we have a saving of $11,208,312, or nearly double the net earnings from the operation on all the street railways of the State.

Looking over our figures, we might be met with that oft-repeated statement that street railways have been overcapitalized. To this charge we cannot but reply that the promoters of some of the street railways have not been entirely guiltless of the sin of overcapitalization to a certain extent, yet far less than is ordinarily supposed. We believe, however, that the aggregate amount of all such illegitimate financiering in connection with the street railways of New York State, since the advent of mechanical traction is not so great as the unintelligent and wasteful expenditure of public funds in one or two large cities of the United States, for a fraction of this period, and we cheerfully invite the advocates of municipal ownership to devote some study to this feature. Where the money represented by the present investments has gone is in the legitimate purchase of underlying companies or companies antedating mechanical traction and in expensive construction and equipment, which could be duplicated to-day at a much smaller figure. Some illustrations of this feature. In the early days of electric traction, when most of the construction and equipment was done in this State, girder rails cost more than double their present figure; electric car equipments from 250 to 400 per cent. more; car bodies from 25 to 35 per cent. more; power station equipment from 100 to 300 per cent. more. That prices have depreciated is not the fault of the railway investors and managers, and surely does not affect the legitimacy of their investments. The public should feel grateful for the additional incentive which the present low prices now give the railway corporations for offering them still better transportation facilities. Somewhat on the same lines, we should refer to the mistaken impression generally prevailing, even among those who are supposed to have some knowledge of the subject, as regards the entire cost of thorough electric railway construction and equipment. As illustrating this, a few months since, I was called upon to prepare a careful estimate on cost of duplicating an extensive street railway system in the West, where the city engineer had stated that approximately $3,500,000 would rebuild the system in accordance with the most approved ideas. The engineer referred to was requested to answer a long list of questions, which practically constituted specifications, as to his ideas on construction and equipment, and a most careful calculation was made by myself and others in accordance with his ideas, the result being that at least $7,500,000 was found to be necessary to duplicate such a system in accordance with the specifications of such engineer. The opponents of the present methods of street railway ownership and operation would probably state that the rapid extension of street railway lines

would not have been made had not additional returns been expected by the investors, and that, to a certain extent at least, the results which we have quoted would verify this statement. Yet, far more apparent than this is the fact that with the extensions of lines have come the transfer system and lengthened routes, so that the average nickel will now carry a passenger three times as far on the street railways of New York than it would have done ten years ago; another illustration of the benefits which the public has derived, and it is safe to say we would hear no comments on the fact, that the rates per passenger had been reduced during the past ten years.

Let us now, for a moment, consider what might have been the result had the street railway management of New York State, as a whole, been less progressive than it has. All of the large systems are practically the outgrowths of old horse car companies, which were generally laid out on the principal thoroughfares, affording a large short haulage travel, and which could now be handled in a most profitable way by mechanical traction methods at an average rate much less than upon systems which have extended their lines, so that a large proportion of their mileage is suburban, or through comparatively unprofitable territory. Let us cite a case from actual records, showing what the effect would have been. A certain street railway system in a large city, operating about thirty miles of track by horse traction in 1887, equipped its lines with mechanical traction, but has never extended the same. It is well managed and gives magnificent service, but cannot be said to have conferred the benefits upon the community which other systems have that have followed the general programme of extension. The following shows the approximate results from its operation in 1887 and 1896:

	1887.	1896.
Gross receipts	$1,346,550.00	$2,680,448.00
Operating expenses	974,794.00	1,448,157.00
Per cent. operating expenses to gross receipts	72.5	54.2
Fixed charges	294,326.00	316,007.00
Net incomes	77,428.00	886,284.00
Dividends	60,000.00	800,000.00

We think no comment is necessary to illustrate this company's prosperity. Nor does it need any elaborate argument to show that in this particular case at least better results could not have been obtained had extensions been built.

We have heard it claimed that the employés of the street railway companies have not profited as they should through the advanced methods adopted by their companies. A glance at the statistics we have quoted illustrates how their number has increased and the following statement will, we think, demonstrate that the condition of the employés of no other large industry in this country has shown as comparatively great improvement in ten years as has that of the street railway employé in the Empire State.

COMPARATIVE STATEMENT OF AVERAGE WAGES AND SERVICES REQUIRED OF STREET RAILWAY EMPLOYEES OF NEW YORK STATE.

	1887.		1896.	
	Wages. Per hour.	Hours. Per day.	Wages. Per hour.	Hours. Per day.
Conductors	$0.141	11.79	$0.159	10.62
Drivers	.141	11.97	.183	10.40
Starters	.184	11.14	.182	10.90
Watchmen	.142	14.09	.145	11.22
Switchmen	.142	10.68	.143	10.44
Roadmen	.158	10.29	.153	10.20
Hostlers	.131	11.52	.145	10.57
Blacksmiths	.252	10.11	..	....
Carpenters	.248	10.14	.200	10.00
Painters	.241	10.22	.200	10.00
Harness makers	.225	10.00	..	....
Inspectors	.217	10.70	.235	9.50
Car cleaners	.148	10.50	..	....
Tow boys	.109	12.31	..	....
Trackmen	.172	10.50	..	....
Repair men	.264	10.00	..	....
Foremen	.215	11.50	.200	10.00
Engineers	.220	11.33	.243	10.37
Motormen	.095	14.00	.161	10.72
Machinists	..	....	.222	9.98
Mechanics	..	....	.219	9.95
Linemen	..	....	.193	10.19
Firemen	..	....	.159	10.81
Electricians	..	....	.227	10.15
Transfer agents	..	....	.200	10.00

We regret that time and space will not permit us to make an elaborate comparison of the wages paid street railway employés here with those prevailing abroad, or to demonstrate at length that electric traction increases the labor account, although it produces economy in other directions. We would note, however, that according to the last report of the Glasgow tramways—the model horse railway system of the world and the ideal of municipal ownership—that the total wages aggregate but 43 per cent. of the operating expenses, while on that model of electric street railways, the Buffalo (N. Y.) system, as shown by its report for 1896, over 77 per cent. of the entire operating expense is paid to labor, while this percentage holds practically good on all the street railways of the State operated by mechanical traction. This analyzed would mean that out of approximately $29,000,000 gross receipts received by the street railways of the State, $13,000,000 are paid directly to employés as wages, while, of course, a goodly share of the remainder of the operating expense goes indirectly to labor in the production of materials required in connection with operation and replacement. Against this, the stockholders of the operating companies get but, approximately, $3,400,000 annually in dividends for their large investment.

Now as to the most serious of all offenses that have been charged to mechanical traction, viz., accidents. The daily press is constantly filled with references to the "Deadly Trolley," with occasional remarks concerning Mr. Vreeland's cars of "Juggernaut," but what are the real facts concerning this very serious matter, and what are the comparative results between the present and the past on street railways in this State, and how does the annual result compare on street and steam railways. According to the Railroad Commissioners' report of 1896, there were killed on the street railways of New York State 13 passengers, 7 employés and 51 others, making a total of 71. This represents one for each 1,807,316 car miles run, or one for each 9,383,258 passengers carried. Against this number the surface steam railways killed 5 passengers, 211 employés and 544 others, or a total of 760. This represents one for each 241,950 train miles run, or one for each 235,941 passengers carried. So it is safe to say on fatalities that our steam railway friends are producing the same in the proportion of about eight to one, as against the street railways. In the same year the street railways injured 197 passengers, 35 employés and 157 others, or a total of 389. This represents one for each 329,875 car miles run, or one for each 1,728,788 passengers carried. During the same period the steam railways injured 174 passengers, 2,142 employés and 592 others, or a total of 2,908, running for each 63,233 train miles, or carrying 61,663. The total killed and injured on street railways was 462, or one for each 277,752 car miles run, or one for each 1,442,016 passengers carried. The total killed and injured on the steam railways amounted to 3,668, or one for each 50,131 train miles, or one for each 48,886 passengers carried. From this comparison it will be seen that if the daily press devoted as much space comparatively to steam railway accidents as to those on street railways they would have room for nothing else in their columns, and might require daily Sunday editions. To listen to some of the comments on street railway accidents, it would be supposed that no such thing had ever been heard of until the introduction of mechanical traction, yet in 1887 the street railways of New York killed one person for each 9,983,646 passengers carried; almost the same average as the present, as shown above. They injured one person for each 1,398,487 passengers carried, or proportionately 25 per cent. more than in 1896. This, we think, thoroughly demonstrates that mechanical traction is far safer than the horse car in every way. But another surprise. While, as shown, the percentage of accidents has been decreased, the natural inference would be that this improvement had occurred in connection with the passengers or employés, and that with increased speed must come greater danger to those upon the streets. Strange to say, however, the proportion of accidents between 1887 and 1896 to this class is 33⅓ per cent. less. It should be remembered in this connection also that the average speed of cars on the street railways of New York State has more than doubled during the past ten years.

The accumulation of statistics quoted has lengthened this paper far beyond my original expectations, until I fear it has became burdensome, and at the same time I may be accused of treating almost entirely subjects which would only indirectly come under the title, yet you are all practically as familiar as am I with the technical and engineering side of electric traction development, so I trust I may be pardoned for not dilating upon the same, and will close with the brief prophecy that another decade will find electric traction occupying the same position as regards operation of heavy standard railways that it now does toward the street railway.

MR. J. D. REID, who has so long been United States Consul at Dunfermline, Scotland, and has been one of the oldest officials in the consular service, will no longer hold that position, but is returning to this country on October 2.

THE CROCKER SAFETY SECTIONAL THIRD RAIL SYSTEM.

FOR some time past an experimental electric railway track has been in operation in the yards of the American Ordnance Company at Bridgeport, Conn., and on Aug. 23 a test of the system was made in the presence of a number of officials of the N. Y., N. H. & H. Railroad, including Col. Hefft, of the Consolidated Road.

The system is due to Mr. E. C. Crocker, electrical engineer of the American Ordnance Company, and its prime object is to render the exposed third rail harmless to persons and animals and to render short circuits, damaging to the station apparatus, impossible. To that end the third rail is divided

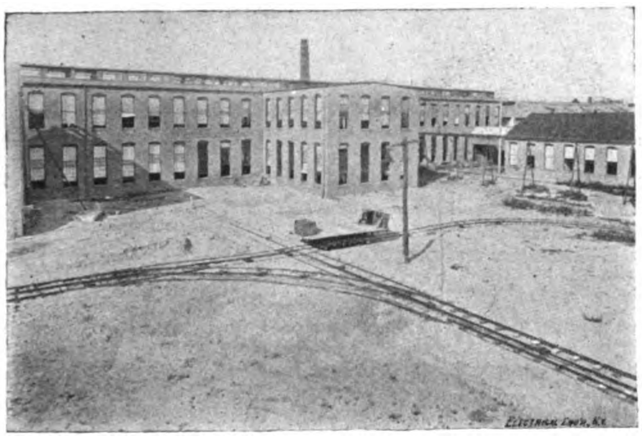


FIG. 1.—CROCKER SAFETY THIRD RAIL SYSTEM.

into sections, which are "alive" only during the passage of the car, being controlled by switches placed in boxes in the ground at short intervals.

The operation of the system will be made clear by reference to the accompanying engravings.

Referring to the diagram Fig. 2 S is the shoe carried by the car; 2, 2A and 2B represent the sectional third raials. 3 represents the feed wire. Fig. 4 shows a sketch of the way the third rail would be laid for street service.

If we start from the shoe S and trace back through magnet 1 it is evident, that magnet being energized by the current, it will draw the lever out of the contacts, the current passing on to magnet 2, energizing the magnets, drawing the lever into the contacts, passing through the contacts of the next box, which are closed from the fact that the car drawing current from the rail before has closed its contacts. The current then passes through magnet 4, drawing in the lever

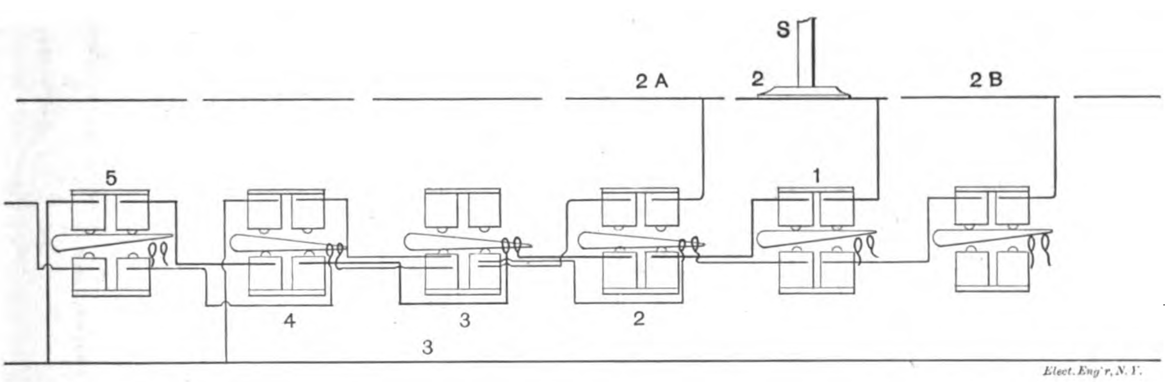


FIG. 2.—CROCKER SAFETY THIRD RAIL SYSTEM. DIAGRAM OF SWITCH OPERATION.

and closing the contacts; passing on to 5, drawing out the lever, opening the contacts and on to the feed wire.

It will become evident by tracing out the circuit that three sections are alive at a time. The current that the car draws cuts in the sections on either side of the section it draws from and cuts out the next preceding ones on either side, and repeats the operation as it goes along. By referring again to Fig. 2 it will be seen that when the shoe S passes on to 2B there will be an absolutely open circuit between 2A and feed wire 3; but if we go in the other direction and S passes on to 2A, then 2B will have an absolutely open circuit between the line wire and rail.

It will be evident that when power is shut off on the car and the car left running the car would slide over the line sections 2, 2A and 2B, and would leave them alive and hence the car could not start up again, as the section underneath would be dead. To eliminate this trouble an automatic switch is inserted with a resistance to use three amperes, so that when the controller is thrown around, shutting off the power from the motor, the automatic switch will drop, close the circuit with a resistance of three amperes, which is abundant to operate the magnets. Then when it is desired to start the motor again the current in the motor operates the automatic switch, cutting out the three ampere resistance, and allowing the motor current to operate the system. Of course it will be evident that in the winter time this automatic switch or the three ampere resistance will not be needed where heaters are used, as the current used in the latter will operate the magnet system.

The magnets are put in a cast iron box, enameled on the

FIG. 3.—THE MAGNET BOX.

inside and sealed so as to be water tight. The enamel prevents any sweating that might otherwise occur. The magnet boxes Fig. 3, are placed in the ground between the rails, over the top of which is run a conduit, into which the wires are run which lead out from the boxes. It will be evident by tracing out the circuit that there are four wires running between each box, which, with the feed wire, makes five.

Of course the third rail sections are made so that the car will cover the whole three sections at all times so as to make it impossible to get a shock from the system unless one gets underneath the car. The system installed at Bridgeport gives perfect satisfaction, nowithstanding that it is put in so exceedingly crudely that many who have seen it wonder how it is possible to operate it at all.

As to the cost of the system, it is estimated that it will reach anywhere from $5,000 to $10,000 per mile, depending on the place and number of boxes per mile. In some places, like steam or country roads, the cost will run as low as $4,000 per mile.

The design of magnets shown in Fig. 2 is not the design that will be put in for service, as the inventors have a method whereby the magnets, as soon as they have operated the switches and closed or opened the contacts, are cut out of circuit and the current goes through a shorter path, which eliminates all danger of the magnets burning out. It will be evident, too, from a study of the sketch, that there is no

possibility of the contacts in the boxes ever arcing or getting out of order, as the contacts, levers and magnets are all built rigidly on a bronze base. The reason that the contacts will not arc is that the circuit is never broken or closed in the boxes, as the section through which current is drawn closes and opens the contacts for sections where no current is

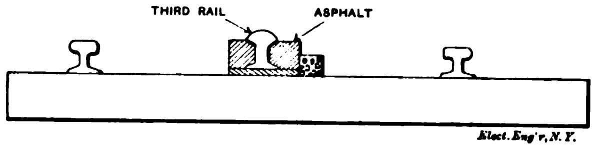


FIG. 4.—SECTION OF TRACK AND THIRD RAIL.

being drawn. The shoe used on the experimental track is a long, flat shoe, 24 x 4 inches, fastened in the middle of the car and held down by its own weight.

The track illustrated in Fig. 1 shows that the experimental installation embodies pretty nearly all the working conditions of practice, including as it does switches, curves, grades, crossovers and terminal facilities.

AMERICAN STREET RAILWAY CONVENTION HALL, NIAGARA FALLS.

As already announced by us, the convention of the American Street Railway Association will be held at Niagara Falls, Oct. 19-22. We are informed that the promised attendance will exceed that at any other convention in the association's history.

What will make the convention of particular interest to members is the exhibition of railroad apparatus to be made by the various manufacturers. This will be held in a special building recently arranged for the purpose, situated on Walnut avenue, midway between the two business sections of the city, and ten minutes' walk from the hotels.

The main floor, shown in plan in the accompanying diagram, Fig. 1, measures 132 x 132 feet. The front of the building, shown in Fig. 2, is two stories high and the upper floor is arranged for a convention hall capable of seating 300 people.

The floor plan shows the space and location of exhibitors. It will be noted that the whole floor has been spoken for and

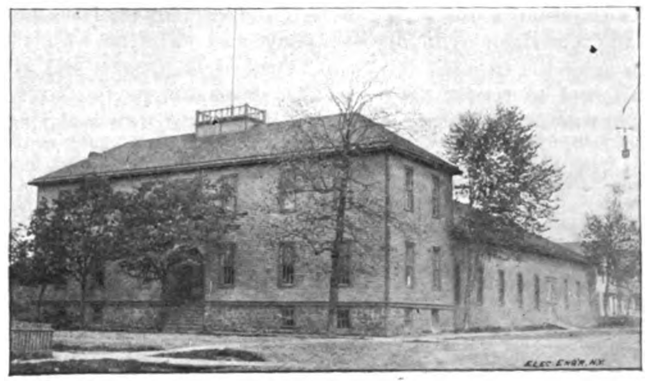


FIG. 2.-AMERICAN STREET RAILWAY ASSOCIATION EXPOSITION HALL.

we are informed that 5,000 feet additional could have been let had it been avaialable. This certainly speaks volumes for the interest taken in the coming meeting.

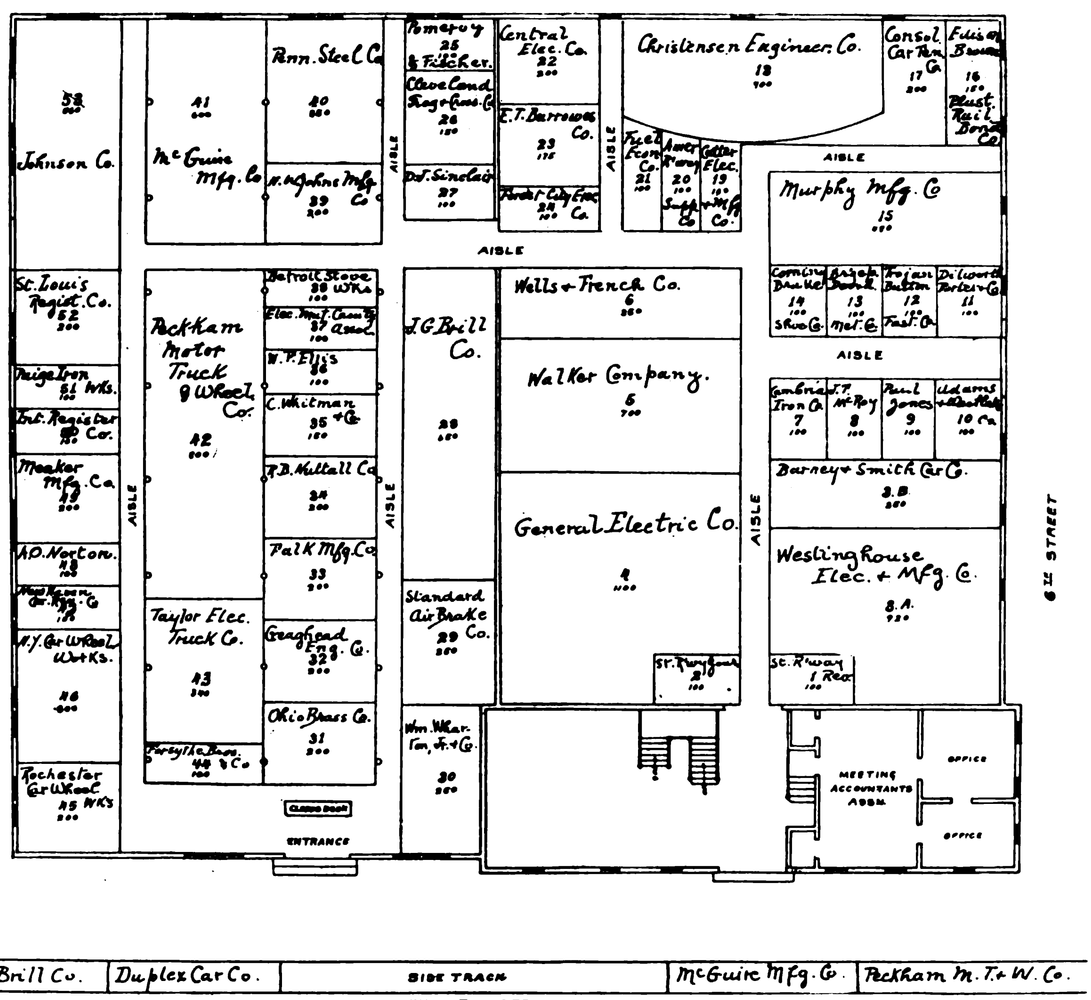


FIG. 1.—AMERICAN STREET RAILWAY ASSOCIATION.—FLOOR PLAN OF EXPOSITION HALL, NIAGARA FALLS.

We may add that the local street railway will run a branch to the hall for freight and passenger purposes, and a branch of the Erie Railroad will also run to the building.

THE JUNGFRAU ELECTRIC LOCOMOTIVE.

THE construction of the electric railway up the Jungfrau is being actively prosecuted, and it is expected that the first section of the road will be open for traffic by next season. All the constructive details have now nearly all been decided on and among the most important are the electric locomotives, which will depend for tractive effort on a rack rail, owing to the gradients which reach as high as 25 per cent.

The trains on this line are very heavy, on account of the endeavors of the management to combine great power with great economy. A train consists of one passenger car with motors on it, and one other car for either passengers or freight. Fig. 1 represents the cross-section, and Fig. 2 the longitudinal section of the car containing the motors and driving gear. The combination of the locomotive with a passenger car gives greater weight on the driving or braking wheels, and hence the cogs are less likely to rise out of the rack should the brakes be applied too suddenly. This arrangement also gives greater economy, in that the total weight of the train is reduced and its carrying capacity increased. The locomotive alone would have to weigh 12 tons, while the combined car as now to be constructed will only weigh 13 tons.

The carriage and the motor truck may be easily separated from each other in case repairs are necessary. The locomotive weight comes upon the two axles, seen in Fig. 2. The spiral springs shown are arranged to be not easily deflected, and their movement is limited to about 2-5 inch. The frame is built like the frame of an ordinary locomotive, and contains between the two supporting axles the two driving axles, on which are the cogwheels. Two electromotors, each of 125 h. p. at 800 revolutions, drive, by means of double reduction gearing, the main cogwheel. These reduction gears are duplicated on each motor, being arranged symmetrically on each side of the same.

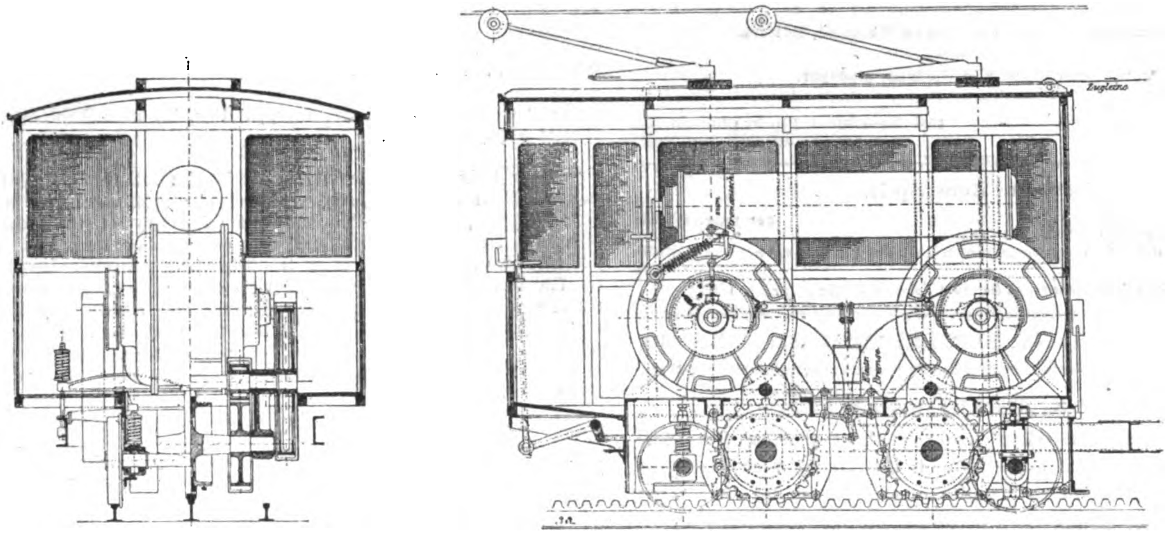
The highest output of these machines will be 300 h. p., corresponding to about 285 apparent kilowatts, or about 235 amperes per phase at a pressure of 500 volts. The pinions are made of aluminum bronze, the larger spur wheels of cast steel, and the driving cogwheels are made of cast steel which has also been wrought. The reduction gears have only a 1¾ inch pitch, and are machine-cut on the skew so as to secure an easy running and no side pressure. The driving cogwheels are made as large as possible in order to get a good grip of the teeth in the rack, and little wear from friction as possible. The driver's cab is enclosed, and is constructed of wood, on account of the cold. The locomotive has the following brakes:

1. An electric brake on the motor shaft, which is available as long as there is current passing through the motors. This brake is combined with the electric governor in this sense that the latter interrupts the current should an excessive speed obtain.

2. A hand-brake which acts by means of levers upon each of the brake blocks on the driving cog. The brake blocks are made of bronze.

3. The third set of brakes acts by gripping the rails. The engineer, as well as the conductor on the upper platform, may operate this brake. The gripping brake may also be used as a regulating brake when descending with the current interrupted.

The Jungfrau locomotive is the most powerful cogwheel locomotive which has been constructed so far. It has a tractive effort of 14,500 pounds. It will work on the three-phase system.



FIGS. 1 AND 2.—ELECTRIC RACK LOCOMOTIVE FOR THE JUNGFRAU RAILWAY, SWITZERLAND.

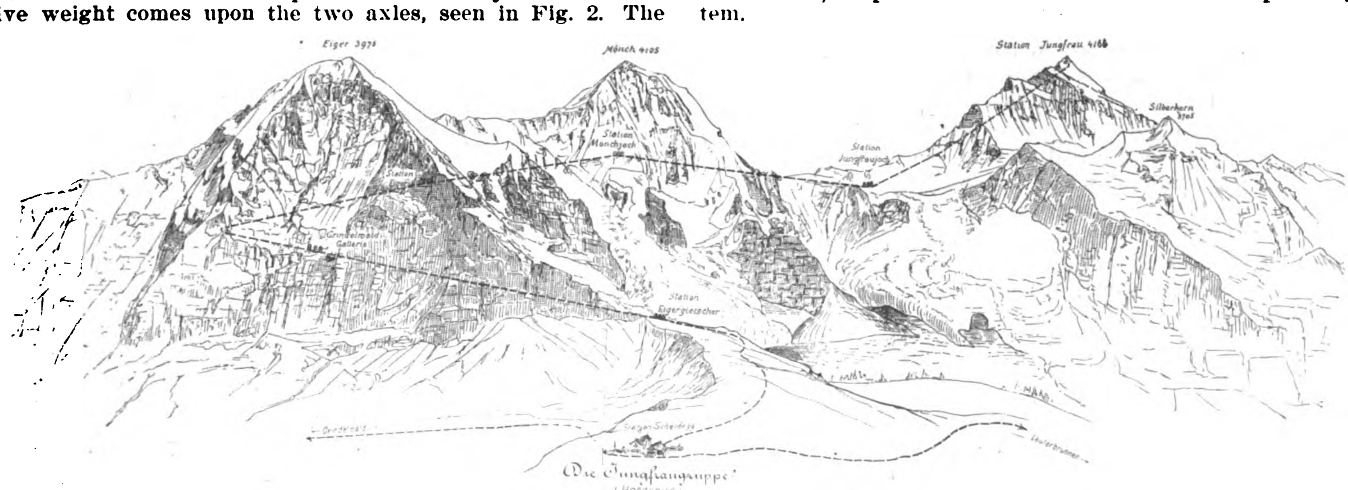


FIG. 3.—THE JUNGFRAU ELECTRIC RAILWAY. PERSPECTIVE VIEW OF ROUTE

The following are some of the principal data of the locomotive and road:

Gauge	1 metre
Maximum grade	25 per cent.
Diameter of driving gear	700 mm.
Number of drivers	2
Diameter of wheels	600 mm.
Speed	8½ km. per hour
Maximum pressure on gear teeth	6,500 kgm.
Speed of motor	800 r. p. m.
Weight of locomotive	13 tons

THE

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[INCORPORATED.]

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MUNICIPAL STREET RAILWAYS.

NEXT to "municipalizing" electric light plants, the idea most in favor with socialists of the Grout and Parsons type is that of "municipalizing" street railways; and they keep on quoting Glasgow as though instead of being one of the worst examples they could possibly cite, it was one of the best—a system which in private hands could be made to yield to the city many times the income and service that it now does under the glorified Bumbledom that is now being crowded upon us as the acme of perfected civilization. We are glad to note that President H. H. Vreeland, of the Metropolitan Traction Company, of New York, boldly and bravely met the issue at the Niagara Street Railway Convention in a very able paper on "Municipal Ownership." He said truly that the time had arrived for a clear understanding of what such ownership means, and his short but exhaustive argument penetrated to the very marrow of the subject. To be personal for a minute, we can readily imagine that a man who by sheer force of character and talent has lifted himself to such a conspicuous position would have many arguments in his mind, not set forth in his paper, against the disastrous modern tendency, if tendency it be, to reduce every large business to a government enterprise, with its deadening system of petty bureaucratic routine and régime.

Mr. Vreeland quotes in his paper the opinions of the courts, the opinions of leading authorities, and the anti-municipal views of the "municipalities" themselves. He states that it would cost the city of New York $295,000,000 to acquire the street railway properties alone; and as to the outrageously absurd statement that municipal ownership would cut the $42,000,000 of annual city taxes in two, he quotes Mr. E. E. Higgins to the effect that the net earnings of all the gas, electric light and street railway enterprises in this city is only $18,000,000 a year!

For his own company Mr. Vreeland, with commendable pride, puts forward a statistical table we cannot refrain from quoting. We only wish that water supply were in hands of a private concern, like this, and the matter of street paving and street cleaning also. Mr. Vreeland says:

"Nowhere in the debate on this subject have I been able to find, even in the statements of the most heated advocate of municipal ownership and operation, any denial of the fact that the centralizing under single management of the various railroads that make up the Metropolitan Street Railway system has improved the public comfort and convenience. The extent and nature of the benefits which this centralizing has achieved is best shown by the statistics. The following table shows the expansion of its transfer system for the last ten years:

Year.	Miles of Track.	Paying Passengers, Total Number.	Transfer Passengers, Total Number.	Transfer Passengers, Prop. to Paying.	Avr'ge Fare (Cents).
1896-97......	190	177,338,677	56,929,611	32*	3.78
1895-96......	172	145,965,251	28,450,996	19	4.18
1894-95......	140	109,686,472	9,671,697	9	4.59
1893-94......	131	107,036,524	5,306,654	5	4.76
1892-93......	80	63,011,785	3,203,832	5	4.76
1891-92......	61	45,259,670	2,645,800	6	4.72
1890-91......	37	39,971,929	2,766,080	7	4.68
1889-90......	36	39,571,464	2,523,239	6	4.70
1888-89......	36	37,386,809	2,206,866	6	4.72
1887-88......	36	37,318,730	1,996,871	5	4.75

*Years ending June 30, except 1887-88 and 1888-89, which ended September 30.

"From this table it will be noticed that in the first seven years about one passenger out of 15 or 20 received a transfer; in the year 1894-95, one out of every 11 passengers received a transfer; in 1895-96, one out of every 5; and in 1896-97, about one out of every 3. The phenomenal development by the company of this great privilege speaks for itself. By means of it, the general fare during the whole day has been reduced to 3.87 cents, and during the crowded, rush hours of morning and evening, when the working people are going to and coming from their work, the average rate of fare is only 2½ cents."

We venture to say that municipal street railways in New York would not do as much for the citizens in fifty years as Mr. Vreeland and his associates have done in five; and that Glasgow will grub along for a quarter of a century before it will be able to carry its citizens 25 miles for 5 cents, as Mr. Vreeland does without fuss or boast.

TELEPHONY IN NEWS TRANSMISSION.

WHATEVER may be the exact facts as to the new terms made between the American Bell and Western Union Companies, it would seem certain that another era has begun as to the transmission of news by telephone, something which the old contract frowned upon and forbade, although the prohibitory clause is said to have often been more honored in the breach than in the observance. A very striking instance of the new work being done is afforded by the recent telephonic transmission of intelligence from the Klondyke to San Francisco and New York. As a matter of fact, the telephone was in use only over a small part of the circuit to San Francisco; but that limitation aside, the work was remarkable in more ways than one. The news referred to had been sent to Mr. Hearst's two papers, the San Francisco "Examiner" and the New York "Journal," from St. Michael's by a staff correspondent. The matter had to be put on the wires on the arrival of the steamer at Puget Sound. From Port Townsend there to Olympia a circuit of 101 miles of telephone wire was available, and the newspaper representative at Port Townsend took the transmitter while a young lady at Olympia with a receiver to her ears, sat at a typewriter, the sheets from which were handed to a telegraph operator in circuit with San Francisco. Dictation began at 9:45 p. m., and was finished at 2:45 a. m., making just five hours, during which time 10,000 words are said to have been taken off with accuracy. The line was that of the Sunset Telephone Company, galvanized steel, running for about half the way through dense forest penetrable only by men when on foot. Of course, the work had been prearranged, and Mr. A. C. Sands, the company's superintendent of its first division, was present in person to supervise it at Olympia.

It will be remembered that there has been much discussion as to the capacity of a telephone line for transmission in bulk. So far as we are aware, this is the first authentic instance of the kind, and we are free to confess some slight disappointment as to the result. Mr. P. B. Delany has been asserting that the telephone and telegraph are on a par, and that, although one can easily talk and hear 120 words a minute intelligibly over the telephone, that is not the real test when it comes to the crucial point of recording. It will be seen that the speed made, over the 101 miles, between Port Townsend and Olympia, was 2,000 words per hour, or about 35 words per minute, if we allow for short interruptions and brief interrogations. It would be interesting to know just how much limitation of speed the use of the typewriting machine imposed. The speed made on that was not at all remarkable, but in

turn was obviously checked by the double strain imposed by the telephone on the young lady, Miss H. G. Hicks, of Tacoma, who received the long message. Are we to infer that 35 words is the limit when receiver and typewriter are thus used together? The question suggests many others, and opens up an interesting field of technical discussion and speculation.

ELECTRIC RAILWAY ADVANCES.

FEW men have been so actively connected with electric-railway exploitation in this country as Mr. W. J. Clark, whose paper on the advances of the decade is begun in our current issue. Merely to enumerate the roads that have been built, started, negotiated, laid out and reported on by that indefatigable and farsighted worker would fill columns of this journal; and it is to Mr. Clark's infinite credit that so little of his labor was done on wrong premises, or has not justified expectations. As his brilliant, yet solid, paper shows, he seeks data for all his results and for all his forecasts; and the picture he presents is one in which those who in various lines of electrical endeavor have toiled shoulder to shoulder with him can also contemplate with great satisfaction. Mr. Clark, it may be said, believes in the early beginning of a steam railway revolution equal to that which has seen the horse supplanted by the trolley; and we trust that ten years hence he may be able to stand up and enumerate the points in which electricity has again, on a larger scale even, benefited the great traveling public. Just at a time when social economists have been deploring the tendency of the population to crowd into narrow city limits, the trolley has set in motion enormous influences working in exactly the contrary direction, and sending great masses of the people out into the suburbs and the country to live. Mr. Clark's paper shows in detail this great fact, which we have summed up in a few words; and it is to be expected that the use of the trolley on steam lines, with smaller and more frequent trains, will aid in this desirable centrifugal movement of the population, by giving them homes of their own and a real stake in the real country.

THE FUTURE OF ELECTRICAL DISTRIBUTION.

IF as short a period as five years ago any member of the Edison Association had got up and advocated the use of the alternating current in any form he would probably have called down upon himself a shout of derision, and who knows but what something worse might have happened to him! The change of sentiment that has come over the electrical fraternity is well illustrated by the calmness and even approbation with which the association at its meeting last week listened to the advocacy of the alternating current as a transmission auxiliary to the three-wire direct current system of distribution in large cities.

Mr. Ferguson, of course, does not stand alone in his appreciation of the benefits to be derived from a judicious use of the high tension current, but the practical acquiescence in the arguments brought forward by him by the majority of the members present shows that chauvinism in electrical matters, as well as in politics, can only lead to retrogression, and that the station manager who would be up-to-date must choose wisely and without passion the means which the modern electrical arts place at his disposal.

What makes Mr. Ferguson's paper perhaps more striking is the fact that he practically discountenances the use of storage batteries as auxiliaries to distribution, in favor of the three-phase high tension distribution with local rotary converters. In this respect Mr. Ferguson's position differs from the stand taken by a number of the larger Eastern Edison companies, who have installed storage batteries to a considerable extent. Of course, no system of rotaries, whether high tension or not, can take the place of the battery as a storer of energy, nor do we, for a moment, imagine that Mr. Ferguson is of this opinion. The point he wishes to bring out evidently is that by means of high tension feeders with local rotary transformers all the generating units can be installed in a single station and there operated under the conditions of highest economy. Perhaps as good an example as the scheme which Mr. Ferguson advocates is that about to be put in operation by the Brooklyn Edison Company, and mentioned by Mr. Ferguson, where three-phase high tension current will be transmitted to various sub-stations and there converted into low tension for distribution on the three-wire system; but even in this instance storage batteries will ultimately in the majority of cases be installed in the local stations to take care of the local peaks, and periods of light load. We believe that Mr. Ferguson's thoughtful paper will have a marked influence on the extensions of the present Edison companies. But while they are now advocating high tension for transmission, one cannot fail to notice the strong allegiance of the old Edison man to the low tension direct current three-wire system as the system, par excellence, for distribution. One cannot help admitting that that system has certainly stood the test of time exceedingly well, and Mr. Ferguson was not too exuberant in his commendation of the system and its originator. There are, indeed, few examples afforded in the history of the arts in which a system has so long and so well served its purpose as has the Edison three-wire direct current system. Nevertheless, it is patent from Mr. Ferguson's paper, and from the work now going on in Edison stations, such as that in Brooklyn, that the old Edison engineers are both willing and able to keep up with the times, and to establish still further the supremacy of the low tension three-wire distribution by calling to its aid the powerful high tension allies now ready to their hands.

INDUSTRIAL PROPERTY CONVENTION.

TWO subjects of great importance came before the American Bar Association at its recent meeting in Cleveland. One, the arbitration treaty between this country and Great Britain, has been the subject of widespread popular interest and discussion; the other, the Convention for the Protection of Industrial Property, was passed almost wholly unnoticed, and yet if carried out in its spirit would remove in a large part the occasion for an arbitration treaty. By the Convention for the Protection of Industrial Property, concluded at Paris, March 20, 1883, and now existing between the United States, Great Britain, France, Belgium, Italy, Spain, Portugal, Holland, Norway and Sweden, Denmark, Servia, Switzerland and Brazil, rights arising from invention or from the reputation gained in trade are regulated and protected. In the case of invention, the favorable policy of this government as to publicity before patenting is extended to European nations, members of the convention, where the rule of secrecy before patenting prevails. Under the convention, a period of time, after the first application, is allowed, in which the acts which usually invalidate a patent, will be ineffective, viz., the publication of a description of the invention, its use, sale or exhibition. This period, which is seven months, is called a period of priority. The theory is that the applications made in all the countries during such period are made on the same day, i. e., on the day of the filing of the first application, and, therefore, that the invention is still secret at the time of the application. It results from the convention that the invention can be freely offered for sale for a period of seven months after the application in one of the countries of the Union, and still be the subject of a valid patent if the same is applied for within the period of delay. This gives an opportunity to our inventors to sell their intellectual productions without the necessity of prior patenting in the countries adhering to the convention. If all of our inventions, patented here, were sold abroad for but $100 each, they would bring into the country a vast sum each year. Trade-marks and commercial names are also provided for in the convention. In no class of merchandise is reputation more valuable than in that of electrical devices. The trade-marks and commercial names connected with these goods are worthy of the added protection which the convention gives. Under the convention, goods bearing false indications of origin are seized at the ports of entry or in the interior, in those countries which permit seizure, and in other countries the importation of articles so marked is forbidden. We are sorry to say that while Congress provided in the Dingley bill for the exclusion of articles bearing the trademarks of our manufacturers, those of manufacturers of other countries adhering to the convention were not noticed. This omission will, we hope, be corrected at the next meeting of Congress.

ECONOMY OF AMERICAN INCANDESCENT LAMPS.

WE print on another page a communication from a well known lamp manufacturer, in which the writer shows in a very clear manner just what degree of efficiency American incandescent lamps have attained. The communication is apropos to a note which appeared in a recent issue of The Engineer, calling attention to the new Maxim mineral filament lamp for which high efficiency is claimed. In the original dispatch containing the announcement the economy of American lamps was stated at a very low figure, so low, indeed, that we exonerated Mr. Maxim from all blame on this score. But it is just as well to have it distinctly shown just what can be done in lamp manufacture on this side of the water and Mr. Rhotehamel's communication will, therefore, be read with interest.

ELECTRIC LIGHTING

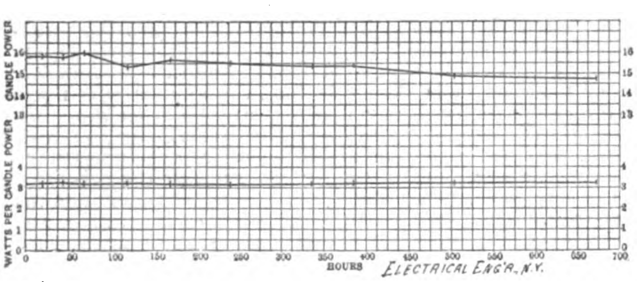
THE NEW MAXIM LAMP AND AMERICAN INCANDESCENT LAMPS COMPARED.

BY J. H. RHOTEHAMEL.

I HAVE noticed the Engineer's editorial on Maxim's new incandescent lamp in the issue of Sept. 2. I had also read the dispatch by Mr. Frank M. White, which has now been pretty generally published in all of the papers of the country.

The statement in the dispatch in regard to the economy of American lamps is in error. The best quality of American lamps average between 3.1 and 3 1-2 watts to the candle. It is stated in the dispatch that the American lamps run 4.8 to 5 watts to the candle. It is also stated that European lamps take 4.2 watts to the candle. The lamp of Mr. Maxim is reported to be a 40 c. p. lamp (voltage not stated), and taking 2.8 watts to the candle. In high candle power lamps one can readily get higher economy than when one makes lamps at 8, 10 and 16 candle power and an 8, 10 or 16 candle power lamp at 3.1 watts is, in fact, a showing of higher economy than forty candle power 2.8 watt lamps considering the relative amount of light furnished. When one attempts to get high economy in very low candle power one cannot succeed so well as if dealing with very high candle power.

The incandescent lamp is not generally understood, owing to the fact that the general public are not familiar with its qualities. The type of lamp manufactured in the United States for several years, and in fact until about three years ago, was of a type such that while starting at a high economy, the filaments increased in resistance to such an extent that the light



TEST OF COLUMBIA INCANDESCENT LAMP.

fell off so much that they soon became lamps of low economy. The lamps manufactured by the writer's company during the past three years possessed the following qualities: The resistance of the filaments from the beginning of its time of burning throughout the entire life of the lamp is almost absolutely maintained. This result brings naturally with it a maintenance of candle power. If the filaments increase in resistance it follows that the light also must decrease. We believe the present filament manufactured by us is superior to any yet attempted and that Maxim's filament, with all that is claimed for it, is not its equal.

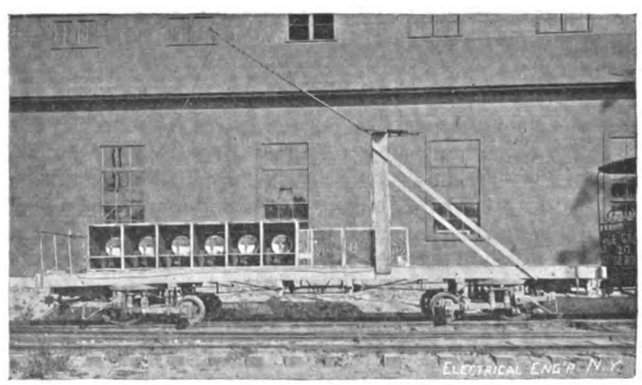
In view of sustaining our claims, I submit a diagram of a test made on lamps made from the filaments of which I speak, which shows the remarkable results outlined therein, and also proves that by the process employed by us in the manufacture of our new cellulose filaments we have obtained a material that practically maintains its resistance and gives a bright light throughout its life. We have already excelled the Maxim lamp in the fact that it is applied to a commercial product in all of the lower candle powers which are required for the purpose of economical illumination.

In reference to the cost of the mineral filament referred to in your editorial we do not think that the estimated cost by you would much exceed the cost of the present type of filament, but we very much doubt if a material from mineral can be made that will produce uniform results; that is, to undertake the manufacture of a certain type of lamp, say a 3.1 watt 110 volt lamp—can you produce filaments from a mineral substance that will give such results as to enable the manufacturer to make lamps that would be marketable in range of voltages? In the old types of lamps formerly produced it will be recalled there was a very great range of voltages. In the present types made by us we are able to guarantee almost absolute uniformity.

I think that the American manufacturer should be treated fairly in this matter and should not be misled by statements in regard to Maxim's lamp that are not correct, and your article does not seem to give any consideration to the quality of the American product in comparison with what Maxim claims. The result of this comparison would show that Maxim has, on the claims made, made no improvement over the American product, assuming that the statement of his correspondent is correct in regard to the quality of the lamp which he claims to have produced.

ILLUMINATING THE NIAGARA WHIRLPOOL RAPIDS.

IN The Electrical Engineer of Sept. 9, a very full account was given of the experiments carried out under the plans and direction of Mr. Luther Stieringer for the electrical illumination of the Niagara Whirlpool Rapids. We are now able to illustrate in the accompanying engraving the simple apparatus used. It consisted, as noted already, of six ordinary G. E. search lights set in plain wooden boxes, painted black inside, with a polished silvered reflector at the back of each. These were put in a bank, with a rheostat, and a switch for letting in the trolley current, and all mounted on a mere flat car. Along the front of the lamps were slid colored mica or gelatine screens, and thus beautiful and weird effects were obtained; the flat car being towed a few yards in front of the cars with passengers. The effects were so unique and so good, an extension and development of the scheme may be expected, and Mr. Stieringer is said to be now working upon the details with his usual thought and originality. Crude as the apparatus was, indications enough were given of the possibilities, and hereafter visitors to the Falls will want to take the Gorge trip by night as well as by day. Mr. S. D. Greene thinks he can arrange for a repetition on a larger and finer scale at the time of the national street railway convention next month.



ELECTRIC PROJECTOR CAR FOR LIGHTING WHIRLPOOL RAPIDS, NIAGARA FALLS.

The lamps will be put higher on the flat car so as to get a range for their beam from one bank to the other, and by means of lamps with a flatter beam, it is expected to illuminate as much as 300 or 400 feet of the "Atlantic in a spasm," at a time. And if this is successful, something will probably be done to make the Falls themselves visible at night, and to fit them up with displays on nights when the lunar rainbows are not due. At night the Falls are now only a voice, and there are rarely any public amusements in town; whereas hereafter by night as well as by day, Niagara will become the greatest show on earth.

THE TACOMA MUNICIPAL PLANT.

At Tacoma, Wash., the special council committee appointed to investigate the conduct of the light plant has made its report to the council. The committee found the plant in a very uneconomical condition. The engines and boilers and auxiliary apparatus were old-fashioned and uneconomical. It will cost about $40,000 to reconstruct the plant, so that it can be economically operated. In the month of May the committee states electricity produced at the city plants cost 2.76 cents per k. w. hour, or a total for the month of $1,752. The same amount of electricity at the rate paid for current now purchased under contract would have cost the city $952. Or, in other words, if the city had purchased its electricity at the rate paid for the day load it would have saved in May $800. This would amount to a saving of $9,600 a year.

ECONOMY IN DISTRIBUTION OF ELECTRICAL ENERGY.[1]

BY LOUIS A. FERGUSON.

EVER since the advent of the Edison Central Station for the distribution of electrical energy for lighting and power work, it has been the universal practice among the designing engineers of both the parent company and the local companies, to confine themselves almost exclusively to the use of the direct current for both transmission and distribution.

Following this idea it has been customary in the development of the lighting and power business of a large city, to erect the original central station in the heart of the business district, laying an Edison underground net work in that section and supplying it by feeders from the station.

With the successful lighting of the business district a demand is created for the electric light in the residence portion of the city, and to supply this the same method is followed as has been employed in the down-town district. Another steam plant must be erected at a central point and the territory covered by a net work of underground conductors. Other districts are covered in the same way until three, four and sometimes five steam stations are generating and supplying electricity to the several portions of the city; in some cases, each supplying its own respective district, and in others, all stations delivering energy into one general net work of conductors, covering the whole territory. It has been the practice in some cities to connect the bus bars of two or more stations by means of direct current tie lines; in some cases the tie lines being used to send current from one station to the other to assist at the time of maximum loau, or to charge storage batteries, or even to furnish the entire output during hours of minimum load in the territory supplied at other hours by a generating station.

In all cities of moderate size or considerable importance the service is furnished twenty-four hours every day in the year, therefore the cost per kilowatt hour of operating in the stations having a small load factor will be very high, especially during the hours of minimum load, which is often sixteen or eighteen hours each day. This has been realized for some time and many methods have been suggested and employed to reduce the cost of operating the smaller stations in the large cities.

We have all listened to the arguments in favor of the use of storage batteries in conjunction with the steam plant in these secondary stations and several companies have employed them. Some of us are using the direct current tie line from the main station to the secondary station to supply the entire output for the secondary territory during the greater portion of the day, operating the secondary stations as a steam plant from dusk until midnight only.

In Boston a storage battery sub-station supplies the residence portion, the battery being charged from the net work during the time of minimum load, and in that city also a tie line connects the main station in Atlantic avenue, with the Head Place Station, charging a battery in the latter station and also feeding the underground system. The direct current tie line is economical and useful for carrying during the minimum hours, the entire output of a residence district station, or other station, having a small load factor, when the distance between the two stations is not so great that the loss of energy in transmission and the interest and depreciation on the cost of the tie line will counterbalance the saving effected by shutting down the residence district station, but when the length of the direct current tie line is very long it then becomes uneconomical, owing to the excessive loss of energy in transmission. The pressure curve of a tie line fed sub-station whose underground net work is not interconnected with the net work supplied by the main station, will be a very bad one, owing to the fluctuations of pressure due to ordinary variations in load, and more especially so if the load on the sub-station be even slightly unbalanced, which condition causes an excessive drop on the neutral of the tie line.

If, however, the underground net work of the main station and the sub-station be interconnected and the tie line between the station bus bars be used only to take such a portion of the sub-station output as will be necessary to give the desired pressure at the sub-station bus bar, then the pressure curve of the sub-station will, without doubt, equal in regularity that of the main station and the use of the tie line under this method will be economical and satisfactory.

While direct current tie lines between stations over two miles apart are useful at times of maximum load and in cases of emergency, this method is not the most economical for shutting down the sub-station under the ordinary conditions existing in large cities, even when storage batteries are employed in the sub-station.

It has been my belief, for several years, that the day has passed when we should erect steam generating stations distributed in the various sections of our large cities, and I feel confident that the greatest and most profitable development in the lighting and power industry will be effected by intelligent combination of the alternating and the direct current, the former being used for transmission and the latter for distribution. I think it is generally conceded by all fair minded engineers in America, experienced in central station work, that despite all the advance in alternating current work in recent years, there has not yet been devised a system of alternating current distribution which possesses the advantages and simplicity of the three-wire direct current system for cities of moderate or large size. This being true, the underground system will remain as it is and any increase in economy of operation must come from the abandonment of steam generating stations, except one, or possibly two main stations located on the water front where multiple expansion condensing engines can be employed and cheap fuel may be obtained. The supplying of the business district will be from the main station by means of the three-wire direct current system if the distance from the station to the electrical center of distribution be less than, say, one mile. The remaining two, three or more stations, as the case may be, which formerly supplied the outlying territory will be abandoned as steam generating plants and will become simply sub-stations, receiving their electrical energy from the main station by means of three-phase alternating current transmission.

Under conditions where the main station is within a mile of the electrical center of the business district and the principal output is furnished by the three-wire system, there will be three methods of supplying the sub-stations, the apparatus in the sub-stations remaining the same in each case:

First:—In the main station we may install three-phase alternating current generators in suitable units to meet the conditions, the combined capacity being sufficient to take care of the entire output of all of the sub-stations. These generators should be built with rotating field and stationary armature and wound for the voltage of the line transmission, which should be from 2,000 to 6,000 volts.

In each sub-station there should be stationary transformers wound to reduce the pressure from that of the line to about 80 volts. The secondaries of these transformers in sets of three should then be connected to rotary current transformers in units of proper size to suit the conditions of the load in the sub-stations. The rotaries should be arranged in pairs, each rotary having an independent set of stationary transformers, and having the direct current side connected to the bus bars of sub-stations on three-wire plan. They will take the alternating current from the line, convert it to direct current at from 115 to 130 volts and deliver it to the bus bars for distribution, giving to the customer direct current as formerly supplied by the Edison dynamos. This method is an exceedingly efficient one and assuming that the efficiency of the alternating current generators in the main station is equal to that of the original Edison dynamos in sub-stations, which is very conservative, then the efficiency of the system from the switchboard in the main station to the switchboard in the sub-station will be from 84 to 86 per cent., based upon the following efficiency in apparatus; rotary transformers 91 per cent., stationary transformers 97½ per cent., line loss 3 to 5 per cent.

The Edison Electric Illuminating Company, of Brooklyn, has adopted this method of distribution for development of new outlying territory, and is now installing apparatus on a large scale.

The second method, which though apparently not as efficient as that just described, when the apparatus is considered by itself under full load, will be found exceedingly useful in developing new territory and for additions to existing plant and may yet, when all things are considered, prove nearly as efficient as the first method.

Instead of installing in the main station three-phase alternating current generators for the express purpose of delivering energy to the sub-stations, we may install in the main stations rotary current transformers so wound that their direct current sides may be connected to the positive and negative bus bars of the main station, and operating conversely to the manner of operating rotaries in the sub-station. They will then take direct current from the main station bus bars, convert it to three-phase alternating and send it through stationary step up transformers which will raise the pressure to the desired voltage required for line transmission. The apparatus in the substation will be exactly the same as that described in the first method. With this second method we have the advantage of only one kind of generating apparatus in the main station, all direct current on the three-wire plan, and further, all current required by the converse rotary to supply the sub-station trans-

[1]Read before the Assoc. of Edison Ill. Co.'s, Niagara Falls. Abstract.

mission will be obtained from the Edison generators in the main station, thus loading them and their engines and increasing their efficiency of operation. This method is being employed by the Chicago Edison Company temporarily, although the apparatus was originally built for the third method, which I am about to describe, and which will ultimately be adopted by that company for all its sub-station work. The apparent efficiency of the second method is 75 per cent. considering the losses in apparatus and line by themselves and not crediting the advantages gained by additional loading of engines and dynamos in the main station.

The third method combines all the advantages of the first and second methods and has none of their disadvantages. The main station in this case is the same as before, having dynamos operated on the three-wire system.

Instead of the three-phase generator, as mentioned in the first method, we will install generators designed and built to give three-phase alternating current, and direct current at the same time in any quantities desired, up to the capacity of the machines. These generators will be practically power driven rotary current transformers and may be directly coupled to the engine, or belted if preferred. They will furnish three-phase alternating current to the sub-station transmission line through step up transformers in quantities sufficient to operate the sub-station, and the balance of their output may be furnished at the same time in direct current to the three-wire bus bars of the main station. As the demand at the sub-station increases the quantity of alternating current delivered by the special generators will increase and the quantity of direct current furnished to the bus bars will decrease correspondingly until finally when the time of maximum load has been reached in the sub-station the generators will be working at their full capacity as three-phase alternators and will be disconnected from the direct current bus bars.

The efficiency of this method from the main station switchboard to sub-station switchboard is from 82 to 84 per cent., considering all stationary and rotary transformer losses and line losses.

It will be seen, too, that with these special generators we have the advantage of working them and their engines at full load all the time, and, therefore, at maximum efficiency, and we also have the additional important advantage of avoiding duplication in machinery and being enabled to use the same investment in machinery for the maximum load, both in the main station and sub-station, when the maximum loads do not coincide, which is the condition ordinarily met with in America.

In many of these sub-stations it may be found advantageous to operate series arc dynamos for municipal or commercial lighting in territory not covered by the Edison net work, and in this case the rotary current transformer becomes an exceedingly useful machine. The shaft of the rotary may be provided with a pulley and belted to a pair of arc dynamos in tandem or to a line shaft to which are belted the arc dynamos to be driven. The rotary may then be used as a convertor of alternating current to direct current, and at the same time as a motor driving the arc dynamos. In this way its capacity may be utilized advantageously and the machine operated at good efficiency.

The rotary current transformer is exceedingly useful in developing new territory, since the machines are very small for their output, and a rotary sub-station will thus require only one-third the space of a steam station of the same capacity, and moreover the investment will be less.

Compared in point of economy of operation with a direct current tie line sub-station, or a storage battery sub-station fed by a direct current tie line, the rotary current transformer sub-station is much more efficient and requires less investment for the same output when the average peak width of the sub-station is over three hours, as is the case in nearly all of our American stations.

We have seen that the efficiency of the various rotary transformer methods range from 74 to 85 per cent., and experience in the operation of storage battery sub-station shows the watt loss through the battery itself to be 25 per cent. In addition to this we must consider the energy required to operate the booster for charging the battery, and also the loss of energy in the tie line between the stations. The labor required to operate the rotary current transformer sub-station is very small, only dynamo tenders being required.

Compared with the ordinary steam station in the residence district the economy of operation of the rotary transformer stations is very pronounced; two-thirds of the cost of fuel in the steam station, and all labor and supplies incident to the operation of the boilers and engines may be saved, and during sixteen or eighteen hours each day the sub-station may be operated with only one man, and without any additional labor in the main station.

In connection with the rotary current transformers in the sub-station, storage batteries may be employed, if desired, to be used as auxiliaries in cases of emergency, but they will not increase the efficiency of the system.

Appreciating the value of broadening the load curve of their low tension stations, a few of the companies have taken up contract arc lighting, both for commercial and municipal service with the result that several of the residence stations which formerly had an average peak width of two to three hours, now enjoy a peak from five to seven hours in width. This tendency to widen the peak width lessens the value of the storage battery in residence stations, owing to its great cost, and increases the value of the rotary transformer method for sub-station work.

The real field for the storage battery as an economizer is in its employment in conjunction with the main steam generating station, erected in the station itself when the latter is located in the electrical center of the district, and at the center of distribution when the main generating station is situated at a point distant from the electrical center of the territory to be supplied. The rotary current transformer methods, besides being more efficient in themselves, when compared with other systems, increase the economy of the main station by loading the units in that station in a manner similar to the storage battery.

The field for economy in the manufacture and distribution of electrical energy has not yet been exhausted, and there remains much that may be accomplished in electrical as well as steam engineering, but the best results cannot always be obtained by adhering to old methods and barring from our doors the experience gained by those who have been thinking along different lines than ourselves.

We must acknowledge the good to be derived from the use of the alternating as well as the direct current, when properly applied, and we should so employ them that we may enjoy the benefit of the advantages of both without the disadvantages of either, and thus devise for ourselves a system of generation and distribution which will be more efficient and more flexible in operation than any method which lies within the reach of the alternating or direct current alone.

ON THE PHENOMENON OF THE ELECTRIC ARC.[1]

BY ANDRE BLONDEL.

It is well known that there is a very large difference of potential, amounting as a general rule to at least 25 volts, between the two carbons of an electric arc. This difference of potential, u, increases somewhat rapidly as the arc lengthens, following the nearly straight law first enunciated by Edlund in 1867 [(1)... $u = a + bl$] to which Mrs. Ayrton has lately given a more accurate and satisfactory shape. The greater part of the fall of potential takes place at the passage from the positive crater, at least so far as we can make out by measuring the potential difference between the positive carbon and a carbon rod plunged into the arc close to the surface of the crater. There are two possible explanations of this great difference of potential between the carbons.

First Hypothesis.—The current encounters a high resistance, especially as it passes from the solid to the gaseous carbon; hence, the great fall of potential. Thermo-electro phenomena, if there be any, are negligible as compared with the potential difference we are concerned with, so that the arc, whatever its exact nature, is "equivalent" to a simple resistance.

Second Hypothesis.—The arc is the seat of a very big counter electromotive force, almost independent of the current, and due either to a thermo-electric effect at the contact of the carbons and the arc or to a polarization of the electrodes. This is tantamount to an assumption that the arc is an electrolytic phenomenon in which, for instance, incandescent oxide of carbon is electrolyzed. The resistance of the arc proper has but little to do with the effect under discussion.

After detailing a series of experiments made to test these theories the author concludes as follows:

It seems to me that these experiments definitely show that the electric arc behaves sensibly, like a resistance, and possesses, in the ordinary acceptation of the term, no counter electromotive force comparable to the observed difference of potential; it is not due, therefore, to an electrolytic phenomenon. With the accuracy obtained we may assert that if there be a residual electromotive force, due to thermo-electric causes, for example, it cannot exceed a fraction of a volt.

[1]Abstract, Journ. de Phys.

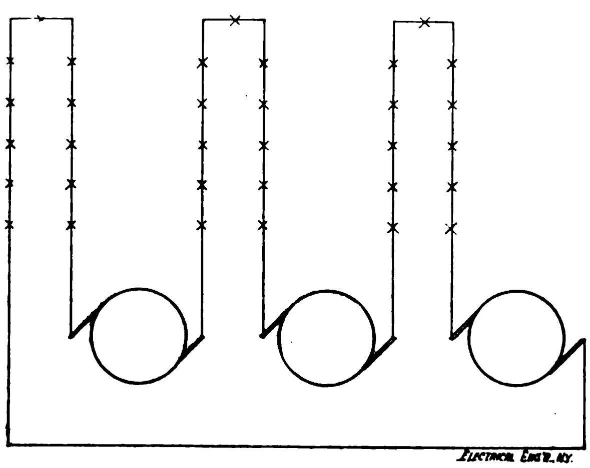
LETTERS TO THE EDITOR

ARC DYNAMOS FEEDING INDEPENDENT CIRCUITS.

Referring to the editorial, "The Future Arc Dynamo," in your issue of July 15, you state that "there are various situations in which 100 arc lamps are distributed on such classes of work that they are operated better on independent circuits. To enable arc machines of large capacity to fulfill this requisite has been the point kept in view in the latest constructions, one result of which is the most recent type of the Brush machine."

From the above it would seem that you considered the Brush machine capable of supplying several independent circuits, but it is not. The Brush machine of to-day is exactly the same in principle and operation as the old Brush machines of fifteen years ago. The latest type machine has three commutators, as before, all working in a single series, but instead of having all the commutators in one group and all the lamps in another group, as is the practice in most stations using the new machines, the lamps may be divided in three groups alternately with the commutators, as shown by enclosed diagram.

With this arrangement on a 150 light machine it is possible to run three circuits on which the voltage will normally not exceed 2,500 volts each, but if the circuit is accidentally



broken, or if the machine flashes, as it frequently does, the lamps all drop their carbons and the whole voltage of three 2,500 volt circuits, or 7,500 volts, to which is added the heavy discharge of the field coils, is piled up in a single discharge and at such times the strain on insulation and risk of life is fully as great as if the machine were supplying a single circuit of 150 lamps.

It is evident that the Brush arrangement of operating a number of circuits in series to keep down the voltage, when things are running normally, cannot be safely used for capacities any greater than for an equivalent capacity on a single unit, for arc machines will flash and circuits will be broken, and with a machine operating 500 lamps the discharge of 25,000 or 30,000 volts would break down any insulation that could be devised and it would require a splendid nerve to handle such a machine.

In my multi-circuit machine, which was described in the same issue, the circuits are all practically in parallel and the maximum voltage that can be obtained in any way is little higher than that required to operate a single circuit, and it is impossible to connect the circuits in series. It is entirely different from the Brush machine and the two should not be considered in the same class.

The interruption of one circuit, or the flashing of one commutator of the Brush machine, puts out the lights on all the circuits, as they are all in series. With my machine each circuit is as entirely independent, as if supplied from separate machines. SAM'L W. RUSHMORE.

Jersey City, N. J.

THE LIFE OF WEATHER PROOF WIRE.

How many years is considered the lifetime or wearing time with absolute safety of No. 8 weather-proof wire, such as is used by the Heissler or other direct current systems for street wiring? O. B.

(Perhaps some of our central station readers will be glad to furnish one of their confreres with the desired information. —Eds. E. E.)

ROENTGEN RAYS

X-RAY DISCHARGES.

Jean Perrin, who has already done much to unravel the complex phenomena of the discharge of electrified bodies by Röntgen rays, has recently[1] made some decisive experiments with regard to the "effet metal," which is concerned in the discharge in addition to the better known "effet gaz." The latter as he showed before, is due to the ionisation of the gas traversed by the rays, and is proportional to the pressure, but independent of the temperature. As regards the metallic effect, it may be separated from the gas effect by a simple contrivance. A beam of X-rays is sent through between two plates of a condenser without touching them. A small piece is cut out of one of the condenser plates and is connected with an electrometer, while the remainder of the plate forms a kind of guard ring. The electrometer then indicates nothing but the gas effect. The same beam is allowed to impinge upon another condenser normally to the plates, and passes through an aluminum window on the second plate. In doing so it traverses a certain thickness of gas, which is made equal to the breadth of the small plate in the first condenser. This insures the identity of the gas effects in the two condensers. In addition, a metallic effect is produced in the second condenser, owing to the impact of the rays upon the second plate. By addition and subtraction the two effects may be separated. In this way it may be shown that the metallic effect disappears when the metallic surface is covered with petroleum, alcohol or water. When the metallic surface is clean the surface ionisation is constant for a given strength of source, distance, metal and gas. It varies inversely as the square of the distance. The constant depending upon the metal and the gas is analogous to surface tension or contact e. m. f., and is called the coefficient of surface ionisation. A definition of the strength of X-rays might be based upon this, but it is better to base it upon the gas effect, and to call unit quantity of X-rays that quantity which in air under 76 cm. pressure liberates in a spherical shell 1 cm. thick, with its center at the source, one electrostatic unit of positive electricity.

DISCHARGE OF CATHODE RAYS.

A fundamental difference between cathode rays and X-rays has been considered to lie in their manner of discharging electrified bodies. Whereas the former only discharge positively electrified bodies, the latter discharge any electrification, of whatever sign. Battelli and Garbasso, in "Nuovo Cimento," prove that cathode rays acquire the discharging properties of X-rays and Lenard rays when "filtered" through a plate of aluminum or glass, but that the change in properties is not due to the passage, but to the change in the medium surrounding the rays. The proof is conclusive. A charged terminal is mounted in the wall of the vacuum tube. A shutter of aluminum or lead is made to slide over and cover it. The discharging phenomena are the same in kind with or without the shutter, though differing in intensity. The discharging properties of Lenard rays are therefore due, like those of X-rays, to the ionisation of the air.

WIRES TO THE KLONDIKE.

It is understood that the Western Union Telegraph Company is contemplating the laying of a cable to St. Michael's, at the mouth of the Yukon River, and possibly putting up a line to the Klondike gold fields by the way of Juneau and over the mountain passes. The first step in that direction has been taken in the decision to lay open a line from Anacortes, Wash., to Victoria, B. C.

[1]Journ. de Phys.

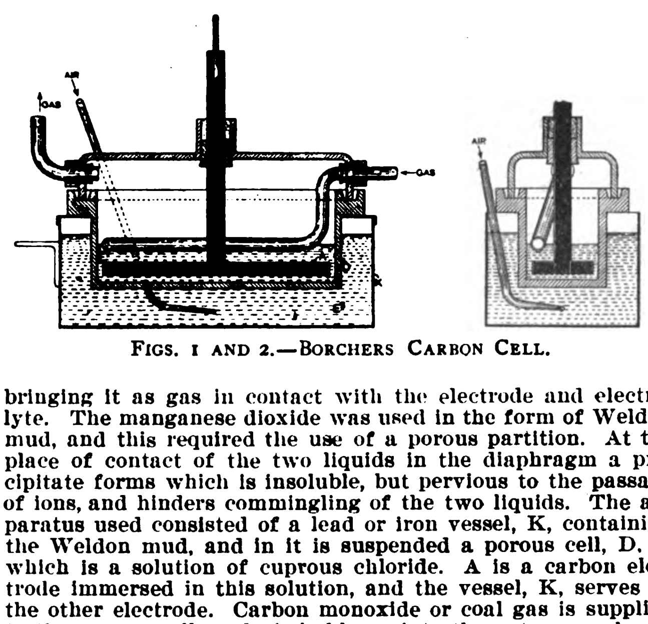
MISCELLANEOUS

THE BORCHERS CARBON CELL.

SOME little time ago Dr. Borchers published an account of a cell designed to produce electrical energy directly from the oxidation of carbon used in the form of its gaseous compounds, notably carbon monoxide. The original idea was to supply CO and air to indifferent electrodes immersed in a solution of cuprous chloride. This substance, having the property of reacting with both oxygen and carbon monoxide, was chosen to bring about the oxidation of the carbon monoxide in such a manner as to produce electrical energy instead of heat. The cell thus contrived was the object of severe criticism, and various experimenters carried out tests which tended to show that the current which was undoubtedly obtained was derived from the dissolution of copper used as an electrode, and was not due to the oxidation of carbon monoxide.

At the annual general meeting of the German Electro-Chemical Society, which was recently held at Munich, Dr. Borchers described various experiments which he had made to determine whether carbon monoxide could be oxidized in an electrolytic cell with the production of current.

Among others he constructed the cell illustrated in the accompanying diagrams, Figs. 1 and 2. In this cell Dr. Borchers used manganese dioxide as a carrier of the oxygen, instead of



FIGS. 1 AND 2.—BORCHERS CARBON CELL.

bringing it as gas in contact with the electrode and electrolyte. The manganese dioxide was used in the form of Weldon mud, and this required the use of a porous partition. At the place of contact of the two liquids in the diaphragm a precipitate forms which is insoluble, but pervious to the passage of ions, and hinders commingling of the two liquids. The apparatus used consisted of a lead or iron vessel, K, containing the Weldon mud, and in it is suspended a porous cell, D, in which is a solution of cuprous chloride. A is a carbon electrode immersed in this solution, and the vessel, K, serves as the other electrode. Carbon monoxide or coal gas is supplied to the porous cell, and air is blown into the outer vessel containing the Weldon mud. The cross-section of the apparatus shown in Fig. 2 makes the arrangement clear. The æration of the Weldon mud may be discontinuous, in which case when the cell ceases to give current the porous cell may be lifted out, a little more lime added to the Weldon mud (which normally contains a certain amount) and air blown through.

Details of the output of cells of this type are given in the form of tables. Thus, using in the porous compartment a solution containing 80 grammes of cuprous chloride, 100 grammes of sal ammoniac, 50 grammes of sulphuric acid, made up with water to a volume of 500 cc., and in the outer compartment Weldon mud as aforesaid, a voltage of 0.61 volt and a current of 0.01 ampere were observed with an external resistance of 100 ohms, and a voltage of 0.07 volt and a current of 0.42 ampere with an external resistance of 0.5 ohm.

DANGERS OF PINTSCH GAS AND TIME TRAIN ORDERS.

A valued correspondent and electrical engineer, who in his early career handled the telegraph key, writes us in reference to the frightful accident which recently occurred on the Denver & Rio Grande Railroad as follows:

Pintsch gas was the cause of many of the deaths. Time train orders instead of definite meeting points was another cause. It appears the freight train had permission to use one hour of the passenger train's time. They used several minutes more than this. When I was a train dispatcher we considered time orders unnecessary and dangerous.

FERRARIS AND ARNO PHASE TRANSFORMER.

The last electrotechnical contribution of the late Prof. Ferraris was a description of "a new system of electrical distribution" by means of the "Trasformatore di Fase," designed by himself and his disciple, Riccardo Arno. It was intended for circuits in which the energy was consumed to nearly the same extent for lighting and for power. The ordinary alternating current was to be sent through the lamps, and the power portion was to be transformed in a special manner to suit the requirements of polyphase motors. The phase transformers have, between the primary and secondary circuit, an intermediate rotating part which is kept in motion on the plan of the ordinary asynchronous motor. Any difference of phase required may be obtained by a suitable adjustment of the number of turns of each coil. The theory of this machine is one of considerable intricacy. It has been attacked by Luigi Lombardi, of Zürich, and compared with practical results. He finds that the transformer obeys most of the laws of the asynchronous motor. Its velocity is very slightly below perfect synchronism. There is a difference of phase between the tension and the primary current which diminishes to a limit as the load is increased. This limit is higher than in the motor, and increases with the difference of phase between the current and the secondary tension. The efficiency is considerably below that of the ordinary transformer, but it may be employed with advantage for starting asynchronous monophase motors.

THE RADIATION OF LIGHT IN THE MAGNETIC FIELD.[1]

DURING the past few months some interesting experiments have been made regarding the partial polarization of radiations emitted by certain luminous sources when they are placed under the influence of a magnetic field. Important investigations in this direction have been made by Dr. Zeeman, of the University of Leyden, who has shown that the perturbations experienced by the ions, under the influence of magnetic forces, produced new periods of luminous vibrations. Continuing this work, Messrs. Egoroff and Georgiewsky (Comptes rendus, April 5, 1897), with the aid of a Rowland grating and a Ruhmkorff coil, have observed a feeble broadening of the lines D_1 and D_2 in the spectra of both axial and equatorial radiations. In investigating the appearance of colored flames of polarized rays by using the Savart analyzer, it was observed that the partial rectilinear polarization of rays directed toward the equator of the magnetic field was easily observed, not only in flames of sodium, lithium and potassium, but in induction sparks between magnesium electrodes. In the cases of carbon, aluminum, mercury, zinc, bismuth and iron, the Savart analyzer showed no in..cation of rectilinear polarization. In a second communication to the same journal (Comptes Rendus for May 3), the results there enumerated may be summed up as follows. The relative quantity of equatorial radiations emitted by a sodium flame, and polarized rectilinearly, varies with the intensity of the magnetic field according to a particular curve. Under the influence of a magnetic field of given intensity, the qauntity of the light polarized rectilinearly, and emitted equatorially by the sodium flame, varies with the temperature of the flame. In studying the change of spectra of metals in a field of considerable intensity, a modification of the method of procedure was adopted, and resulted in the discovery of the rectilinear polarization of the equatorial radiations. Nearly all the metals employed—namely, Cu, Tl, Zn, Cd, In, Mg, Ca, Ba, etc.—showed polarization exclusively for those rays that are easily reversed. The phenomenon, the authors state, "is observed in a very instructive manner for the copper in the green part of the spectrum (the change is very large for the ray 5,105, most feeble for 5,153, and zero for the long waves 5,217 to 5,292). For indium, the change only occurred for the violet ray at 4,510, while the others (6,193, 5,230, 5,900, 4,680, 4,616 and 4,638) were not influenced by the field at all." In experiments with Geissler tubes containing hydrogen and helium, no definite results up to the present have been obtained.

In the experiments just referred to, it may be mentioned that all the observations were made with the eye. It would, however, be interesting to inquire whether the photographic plate would register these small variations, for then we should have a permanent record of a phenomenon which is not so very easy to observe, or which, at any rate, might be subject to

[1] London Nature.

"personal" error. The application of photography to show such effects has been accomplished by Mr. Alexander Anderson, assisted by Mr. Adeney. They employed a Rowland grating of 21.5 feet radius, and obtained photographs of the cadmium spectrum, the source of light being a spark between cadmium electrodes from the secondary of a large induction coil.

The result was negative. To account for it Mr. Anderson suggests two possible resasons, viz.: that perhaps the magnetic field was not of sufficient intensity, or that the exposure (thirty minutes for the narrow slit) was not long enough. He states, however, that with an eye piece in place of the camera, he "saw (or fancied he saw) a widening of the lines."

The whole phenomenon of the widening of the lines in the spectra of metallic substances in a magnetic field is, however, of great interest to both physicists and astro-physicists, and it is important that both eye and photographic results should be obtained when possible.

WAGE SCHEDULE AND RULES GOVERNING ELECTRIC APPRENTICESHIP IN BOSTON.

AT a recent meeting of Local 35, National Brotherhood of Electrical Workers, the following schedule of wages and rules governing electrical apprenticeship were adopted:

Eight hours shall constitute a day's work. Time and a half for all overtime.

A first-class man shall be capable of doing all kinds of work appertaining to electrical construction in his class in a workmanlike manner, from start to finish. His wages shall be not less than $3 per day, except when selected to take charge of work as foreman, with three or more men under him, when he shall receive not less than $3.50 per day.

A second-class man must be able to do work when so directed in a workmanlike manner. His wages shall be not less than $2.50 per day.

It was decided that owing to the nature of their occupation an apprenticeship system is necessary and will tend to conserve the public safety, as well as advance the material well-being of electricians.

Acting in accordance with this decision, the following apprenticeship system was adopted:

Section 1—A person starting to learn the trade, if of good character, shall be admitted to the union as an apprentice, providing he has attained the age of 18 years.

Sec. 2—The initiation fee for an apprentice shall be $2.50.

Sec. 3—Apprentices shall not be allowed to finish work in any branch of the trade under two years' service.

Sec. 4—When an apprentice has completed his second year he shall be examined by the examining board hereafter provided for, and if found competent, shall be promoted to the rank of journeyman, and shall not again work for less than journeyman's wages.

Sec. 5—An examining board, consisting of three members appointed by the president, shall have full power to decide on the competency of the applicant.

Sec. 6—Each applicant for examination shall pay $1 on making his application, and if successful in his examination, shall pay balance of journeyman's regular initiation fee, inclusive of all money heretofore paid him, to the union. This does not include regular monthly dues and assessments.

Sec. 7—The rate of wages shall be hereafter provided for by the union.

Sec. 8—Any questions arising regarding apprentices which these articles do not embrace shall be decided by a committee of three appointed by the president.

Sec. 9—Only one apprentice shall be allowed to one wireman.

At the last smoke talk of the Local 600 members and visitors were present. Addresses were made by a number of prominent labor leaders and entertainment furnished by talent from several theaters.

DETERMINING THE HEIGHT OF CLOUDS BY SEARCH LIGHTS.

A method of determining the height of clouds, and especially of the ill-defined stratus cloud, by means of the search light, was suggested by Prof. Cleveland Abbe many years ago. It was proposed to establish a search light, the beams of which should be vertical; the apparent altitude of the centre of the luminous spot of the cloud was to be observed from a station not far away, and the height was a matter of easy calculation. Prof. Abbe returns to the subject in the Monthly Weather Review (May), and points out that with the great increase in the power of the modern search light, further applications have become practicable; thus in harbors on the sea coast, where one wishes to ascertain the presence and development of low-lying fogs, the search light which renders them visible is an invaluable assistant. A year ago some accounts were published relative to the cloud effects on Mount Low and Pasadena. According to these accounts Mount Low is about fifteen miles north-northeast from Los Angeles, and about six miles in a straight line from Pasadena. When the beam of light fell upon the bodies of clouds they at once became luminous, so that all the details of motion were visible; when the beam fell upon the falling rain, the great cone of light glowed like molten metal. It seems, concludes Prof. Abbe, that the formation and motion of fog and cloud at night-time could be advantageously studied by means of the search light. The height at which fog first forms, and its gradual extension upward and downward during the night, would be a very interesting and profitable investigation.

LOSS OF HEATER EFFICIENCY IN GAS ENGINES.

Mr. H. C. Fairbanks, of Sibley College, while reconstructing a gas engine, observed a singular though probably not exceptional phenomenon which, so far as known, has not been previously described. The machine exhibited a great loss of heater efficiency, which was unaccounted for and was not affected by any changes made in the process of general repair. Finally it was suspected that the conductivity of the metal of the cast iron "fire pot" had been impaired by oxidation or otherwise, and it was replaced by a new one. The engine at once started off at full power and regained its original efficiency.

GRUNDZUEGE DER ELEKTROCHEMIE. (Elements of Electrochemistry). By Dr. W. Loeb. Leipzig, 1897. J. J. Weber. 140 pp.; 6½ x 4½ in. Ill. Cloth. Price, $1.

This is a useful condensed handbook of electrochemistry, containing all formulas, tables and other necessary information for laboratory work.

ELEKTROCHEMISCHE UEBUNGSAUFGABEN. (Electrochemical Practice Exercises). By Dr. Felix Oettel. Halle a. S., 1897. W. Knapp. 53 pp.; 9½ x 6½ in.

This little work, originally intended to serve as a basis for a series of lectures and experiments on electrochemistry, furnishes a compact introduction to the electrochemical branch of science and illustrates by 33 experiments operations and reactions in inorganic as well as organic chemistry.

JAHRBUCH DER ELEKTROCHEMIE. (Yearbook of Electrochemistry). Third year, 1896. By Dr. W. Nernst and Dr. W. Borchers. Halle a. S., 1897. Wilhelm Knapp. 1897. 359 pp.; 9½ x 6½ in. Ill. Paper. Price, $6.60.

This report on the progress of electrochemistry for the year 1896, gives besides a complete list of the patents issued in the United States, England and Germany, a review of the present state of electrochemical industry, especially of the manufacture of caustic alkalies and chlorine and of calcium and other metallic carbides. The contents are divided into two headings: I. Scientific Electrochemistry, treating on electrolytic conductivity, galvanic current generation, polarisation, electrolysis, etc., and electroanalysis. II. Applied Electrochemistry, reviewing the improvements made during the past year in the industries, especially secondary batteries, alkalies, galvanoplastics, metallurgy, etc. It is a most valuable record.

ELECTRO-METALLURGIE, VOIE HUMIDE ET VOIE SECHE. PHENOMENES ELECTRO-THERMIQUES. (Electrometallurgy, Dry and Wet method. Electrothermal Phenomena). By A. Minet. Paris, 1897. Masson & Cie., and Gauthier-Villars & Fils. 195 pp. 7½ x 4½ in. Price, $2.

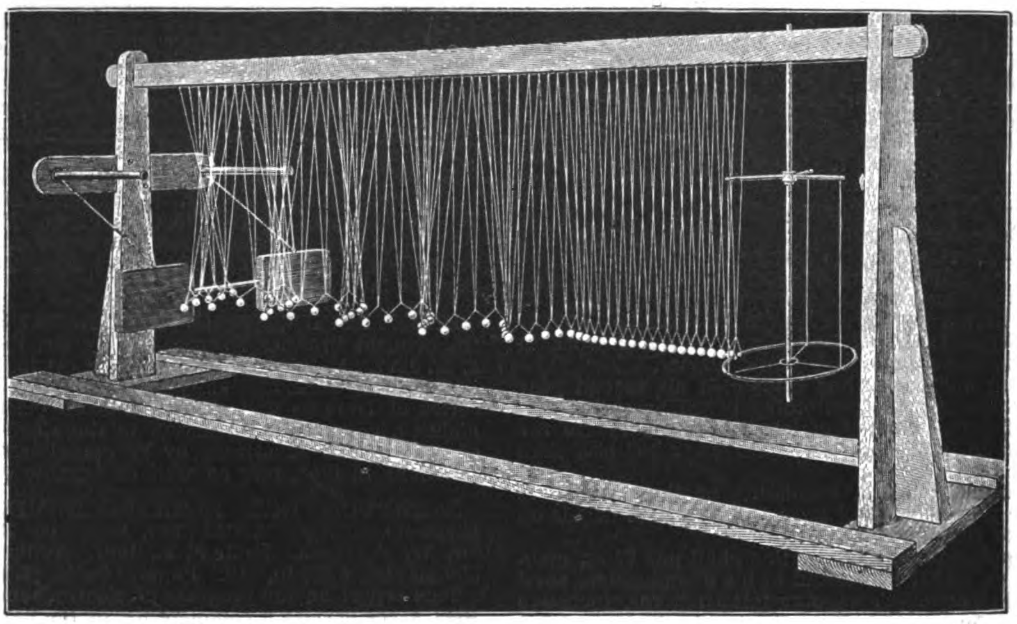
This is a valuable handbook on electrometallurgy describing the principal processes and operations of both the dry and the wet method. The latter includes metallic depositions, refining metals (copper, lead, silver, nickel) and the treatment of minerals, based on the electrolysis of salts in solution. The former describes the electrolysis of anhydrous salts in the state of fusion as applied to the production of the metals, such as aluminum, magnesium, sodium, lithium, zinc, etc., and the preparation of the metallic carbides, such as calcium carbide, etc. The work furnishes in its two parts a complete review of the present state of electrometallurgy.

NEWS AND NOTES

A HERTZ WAVE MODEL.[1]

BY PROF. S. P. THOMPSON.

IN the spring of the present year I showed, at a meeting of the Physical Society of London, a wave motion model which I designed to illustrate mechanically the propagation of a transverse wave. As the exhibition of this model on that occasion, and subsequently at the Royal Society and Royal Institution, has elicited a number of inquiries about the apparatus, it is thought that the following brief account of it may be of some interest to lecturers on physics, particularly at a time when the propagation of electric waves through space is occupying much attention. The apparatus, which is depicted in the accompanying cut, is mounted on a strong wooden frame about 2 metres long. At one end (the further in the cut) is the "oscillator," a heavy mass of brass hung by two strong V-cords from arms which project parallel to the longer dimension of the frame. This mass, which, for the sake of analogy, is quite unnecessarily shaped to imitate an orthodox electric oscillator, can therefore be set swinging in a transverse direction by a suitable impulse given by hand. At the other end of the frame (the nearer in the cut) is the "resonator," a circle of brass wire hung by a tri-filar suspension. Oscillator and resonator must be adjusted by shortening or lengthening the cords so as to have identical periods of oscillation.



PROF. S. P. THOMPSON'S HERTZ WAVE MODEL.

The real problem in the construction of the apparatus was to find a mechanical means of transmitting the energy of the oscillator in visible waves to the resonator. The means finally adopted was a series of inter-connected pendulums on a plan somewhat similar to one suggested in 1877 by Prof. Osborne Reynolds. Instead of using springs, however, the requisite inter-connection is obtained by simply suspending the leaden bullets which act as pendulum-bobs by V-suspensions which overlap, and which, as shown in the cut, are tied together at a point about 4 centimetres above each of the balls. No ball can be laterally displaced without tending to drag its neighbor also; so that a shearing stress is transmitted along the line of balls.

As Reynolds showed twenty years ago, the velocity of propagation of the wave front differs from that of the group of waves owing to the continual dying away of the amplitude of the advancing waves. This effect, due to the inertia of the medium, is of course equivalent to the presence of dispersion in the medium, waves of different frequencies being propagated with slightly different velocities. So far, therefore, as Prof. Fitzgerald remarked when the model was exhibited, it illustrates the propagation of the wave in a refracting medium rather than in the ether of space. The waves in the model travel quite slowly; and there is a fascination in watching their progress along the row of balls, until they arrive at the resonator and set it into responsive vibration. There is, of course, no attempt made here to represent the magnetic part of the electromagnetic wave, at right angles to the electrostatic part; the mechanical displacements in the model corresponding to the electrostatic displacements of the Hertzian wave. A row of inter-connected pendulums such as this affords a means of illustrating many points in physics. For many purposes the elaborate system of suspension by strings may be replaced by a continuous fabric. Thus, for example, a piece of netting, hung on hooks from a horizontal rail, and ending below in a short fringe, with leaden beads on the fringe tips, will also serve to illustrate the propagation of a transverse wave. The structure adopted absolutely refuses to transmit longitudinal disturbances; there being no compressional elasticity between the balls to propagate a longitudinal wave.

[1]London Nature.

ELECTRICAL DETERMINATION OF MOISTURE IN SOILS.

An electrical method of determining the moisture content of arable soils is described by Messrs. M. Whitney, F. D. Gardner and L. J. Briggs, in Bulletin No. 6 of the U. S. Department of Agriculture (Division of Soils). For a long time the importance of having a trustworthy and convenient method for determining the amount of moisture in soils has been recognized. It is pointed out that the rain does plants but little positive good until it enters the soil, where it can be absorbed by their roots. A record of the actual amount of water in the soil from day to day would, therefore, give the absolute value of the moisture conditions under which plants are growing, and even without reference to rainfall data it would show, if the character of the soil was understood, whether the conditions were favorable or otherwise for the crop. The difficulty has hitherto been to make this determination easily; for though various methods have been tried, very little success appears to have been achieved. The method described in the present bulletin seems, however, to be practicable and readily carried out. It consists in burying specially constructed electrodes in the soil, so that by measuring the resistance to the passage of a current through the soil the amount of moisture in the soil can be determined. The possibility of using the electrical resistance of soils for the determination of moisture was suggested to the authors some years ago by the necessity of thoroughly grounding lightning rods, telephones and telegraph lines. If these are not carried to a considerable depth so that the terminals are constantly in a moist soil, the lines do not work in dry seasons. A fair number of observations have been made with the instruments described, and they appear to be satisfactory. The work was begun before the modern conceptions of the nature and principles of salt solu-

tions and electrical conductivity had been developed, and it has been brought to a successful termination by regarding the soil as a difficultly soluble compound, and the soil moisture as a salt solution derived therefrom. The research is thus not only interesting from a practical point of view, but also from the standpoint of physical chemistry.

THE FIRE AT THE NASSAU RAILWAY CO.'S SHOPS IN BROOKLYN AND ITS LESSON.

BY JAMES F. HOBART.

THE fire which destroyed all but the paint room of the Nassau Street Railway Company's shops in Brooklyn, on the morning of Sept. 3, revealed some object lessons in car shop and shed building which all street railway managers will do well to heed as thoroughly as will the managers of the Nassau road.

The burned portion of the shop consisted of two parallel brick and iron structures, originally put up for car sheds. The walls were of brick filled in between Pencoyd iron I-beams, ten inches deep by four and one-half wide. The roof was a truss of angle iron built over eight-inch girder beams, and covered with corrugated galvanized iron. The sheds did not have a particle of wood in their construction, except the window frames and doors, with the exception of the overhead frame trusswork for use in raising cars over the pits.

In spite of the so-called fireproof construction, the building burned fiercely, and made one of the hottest fires on record. The iron roof was bent and twisted out of all semblance of its original shape, and in clearing away, it was necessary to cut nearly all the rivets in order to get the twisted mass into pieces small enough to be carried out of the ruins. Twelve of the trusses fell in, and being heated red hot, they were bent and twisted as above, making the cost of removal so great that, added to the first cost, the figure will be brought above that of a slow burning form of roof construction. It is safe to state that the Nassau Company will never put up another roof like the old one. The tar and gravel roof, or a flat roof of similar construction will probably be used.

Owing to the combustible material, consisting of cars and other wooden matter, contained in the shop, there was fuel enough to melt portions of the machinery. So hot was the fire that a portion of a heavy iron planer was melted where it stood. The hand levers or cranks on the feed screws actually melted and ran, the pulley melted on the countershaft overhead; the gear on a bolt cutter nearby actually melted and ran down over the hub of the gear.

This part of the shop (in the rear of the original car sheds) was fitted with an ordinary flat roof. It is conceded that the fire caught in this part of the shop in the armature room, in fact, and spread thence through all parts of the buildings. A portion of the third shed was saved, but the roof has been removed from the whole as one end was badly damaged.

It is thought that the fire was set by electricity, and, as it first started in the armature room, the testing connections may have been the actual starting point. A suggestive point in this connection is the habit of some of the foremen of lighting their cigarettes from the testing contacts. As these contacts hang on a wooden post in the new temporary armature room, another fire from this cause may perhaps be looked for if the workmen happen to go home nights without pulling the plug which cuts out the test wires.

From the foregoing account, the writer cannot but draw the following conclusions: The iron pitch roof was a great failure. The intensity of the fire was augmented by the chimney-like action of the high roofs which remained in place for a considerable time and acted as chimneys or funnels to increase the draft, and consequently the fire. The cost of warming the sheds was much greater on account of the enormous cooling space in the roofs. The discomfort of the men, and the consequent reduced production from the same cause, was considerable, and could be reduced by a flat roof on the buildings.

Heavy yellow pine timbers, at least twelve by fourteen inches, and trussed over the longer spans, should be used for the roof beams, and the roofing itself should consist of tongued and grooved spruce at least three inches thick, with tarred paper and gravel on top, or mica roofing may be used to advantage. The roof beams must be spaced not less than ten feet apart, and supported on stones, or iron plates set in the brick walls where the increased number of roof beams, over the original number of iron roof trusses, does not allow the wooden beams to bear upon the iron beams set in the walls.

All the roof beams should be well anchored to the walls, and star washers outside of the building should be used to increase the holding surface of the screw bolts used to anchor the wooden beams. Proper ventilation and lighting should be provided for by a monitor on the roof, glazed with sash controllable by chains or wire cords from the working floor of the building.

Fire walls, regular brick bulkheads, should be interposed between the car sheds and the shops proper, and openings in these fire walls should be provided with tinned wooden fire doors which should be kept closed at night by the watchman. The departments should be separated by brick, instead of wooden partitions. The armature room especially, to be made of brick, and fireproofed by asbestos sheathing over all the exposed woodwork.

In addition to the above, there should be a most rigid system enforced in the location and insulation of all wires carrying current. At present, in more than one shop, the wiring is not all it could be as far as safety is concerned. The matter of using railway current for testing purposes should be promptly and totally abolished in every railway shop or car barn, and a separate machine used to generate a testing current. A separate testing circuit should be arranged to cover all parts of the establishment where current is likely to be used for testing. The testing generator should only be run when needed, or at least during working hours.

The armature room machinery in any shop may well be, and often is, driven by a separate motor. Then, the testing generator should be driven with the other armature room tools from the same motor, and this being done, there will be no current attached to bare and loose terminals, when the armature room is shut down. Consequently, there will be no fires started from railway current in the armature room or any other department, by plugs or switches being left in position to keep testing currents on at night.

GAS FOR POWER PURPOSES.

It may be accepted that gas engines of 50 i. h. p. and upward may be worked, under usual conditions, with 1 lb. fuel per i. h. p.; but it is right to point out that these results cannot be obtained with all kinds of fuel. For heating furnaces and other such work, generator gas can be made with bituminous coal, but for engine work gas so made carries too much tar and other impurities. To avoid this trouble the generator gas used for engines is made with anthracite coal or coke. The price of the small anthracite is 6s. to 7s. a ton at the pits in South Wales and near Glasgow, and for the south and west of England, and in most parts of Scotland, the cost of this coal delivered is about the same as that of steam coal. In the Midlands and northern counties it costs more, and then local coke is used.

Lately Dr. Mond has been working a gas plant with bituminous coal, and in his special treatment of the gas it can be used for engine work, but at present he can only work his process continuously, night and day, in a plant capable of serving not less than 2,000 i. h. p., so that for ordinary purposes it is not suitable. It is tolerably certain that sooner or later engines will be worked with bituminous coal; but without waiting for that particular result, the fact remained that great economy is already effected by using anthracite or coke.

Another important feature of gas is that it does not condense or lose power on its way to the engine; on the contrary, the more the gas is cooled, the better it is for the engine, as each charge of gas which enters the cylinder is more dense, and has consequently greater energy. With steam the reverse is the case; there is also trouble with leaks in the piping, but with gas there is no such trouble, as the pressure is low. One result of being able to convey gas any distance in pipes, without deterioration, is that there can be a separate engine in each department of a large factory, with light shafting for each. It is no longer necessary to have heavy shafting to drive the whole of a mill or factory from engines placed near the boilers.

The electrical transmission of power in shipyards and other works covering a large area is now being adopted extensively, and in this way some of the loss from condensed steam is avoided. But the power for driving the dynamos still has to be provided, and the most economical is gas power. One of the leading firms on the Clyde is now putting in a large gas plant for this purpose. There are also several instances of gas power being used for electric lighting, as well as for pumping water, pumping sewage, etc.

The stand-by loss of a steam boiler is considerable, whereas that of a gas generator, capable of serving 200 h. p. is only 3 lb. to 5 lb. per hour.

As to the fuel consumption of steam engines, it is usual to

say that non-condensing engines require 2 lb. to 3 lb. coal per i. h. p., but it may be well to remember the words of Sir F. Bramwell in his presidential address in 1885, concerning engines working under ordinary practical conditions:

"In an investigation instituted last year by the Corporation of Birmingham, when considering whether they should approve of a proposal to lay down power-distributing mains throughout their streets, it was found on indicating some six non-condensing steam engines taken indiscriminately from among users of power, and ranging from 5 nominal h. p. up to 30 nominal h. p., that the consumption in one instance was as high as 27.5 lb., while it never fell below 9.6 lb., and the average of the whole was as much as 18 lb."

A STATUE TO SOEMMERING.

On August 8 last, at Frankfort-on-Maine, a statue of the Frankfort physician, Samuel Thomas von Soemmering, was unveiled. Dr. von Soemmering's name is well known in connection with the early history of telegraphy. The statue, which has been executed by Petry, is a life-sized figure of Soemmering, and next to him is represented an electric battery connected to his electro-chemical receiver. The granite pedestal of the statue bears the words "S. Th. v. Soemmering, Erfinder d. elektr. Telegraphen."

THE HENRY DIFFERENTIAL AMMETER.

A STATIONARY differential amperemeter has been designed by Mr. John C. Henry, of Denver, Col., as a car fixture. It is an instrument that indicates to the motorman the amount of current absorbed by either motor independently and also shows on an enlarged scale with the same pointer the slightest discrepancy between the working of the two motors.

The instrument has an alarm attachment, which rings a bell the instant the motors become unbalanced (which alone can be occasioned by mechanical or electrical trouble), thus enabling the defective motor to be cut out, and having the "stitch taken in time." The alarm bell is also arranged to ring whenever the motors are being abused by careless handling of the controller or from overload of the current.

The same instrument is also manufactured without the alarm attachment, in a portable form, for inspectors. The first experience with the instrument exposed defects heretofore unsuspected on over 40 per cent. of the cars tested. The defects were generally cases of waste of current, which tended to weaken the motors and get them in condition for easy failure.

Car tests made with the Wheatstone bridge voltmeter magnetos or other instruments which handle but delicate currents are unreliable and misleading when used on circuits having superficial contacts, such as brushes, controllers, switches, etc. The differential ammeter tests the entire car circuits with the current required by the motors and thus exposes defects which delicate instruments conceal.

PERSONAL

MR. J. C. DUNCAN, of the People's Telephone and Telegraph Company, of Knoxville, Tenn., was a visitor to New York last week and was a welcome caller at the office of the Electrical Engineer. Mr. Duncan operates a successful telephone exchange in Knoxville and speaks encouragingly of the outlook in the South for independent exchanges. Mr. Duncan had not been North for many years and was much interested in the great changes in the Metropolis since last he visited it.

LORD KELVIN, accompanied by Lady Kelvin, has returned from his trip over the Canadian Pacific and is resting at the house of Mr. J. Bottomley, Southampton, L. I. He will visit the Dominion again before leaving for England.

MR. HERBERT LAWS WEBB, of the New York Telephone Company, has been called suddenly by cable to England on expert telephone work, and left on the steamer on Saturday last.

PROF. S. P. THOMPSON has just returned from his trip to Vancouver, after the Toronto B. A. meeting, and is now making a few visits in this vicinity and New England prior to his return home.

MR. A. K. BAYLOR, who for about a year past has been in England as electrical engineer for the British Thomson-Houston Company, arrived here last week from London.

PATENT NOTES.

INDUSTRIAL PROPERTY CONFERENCE.

A meeting for the revision of the Convention for the Protection of Industrial Property concluded at Paris, March 20, 1883, is announced in "La Propriété Industrielle," of Berne (the organ of the Union formed by the convention), for December 1, 1897, at Brussels. In the course of a recent interview Hon. Francis Forbes, delegate to the last meeting under the convention, said he considered the coming meeting of great importance, because our people have heretofore availed themselves but little of its advantages. For example, Article 4 says:

"Any one who shall have regularly deposited an application for a patent of invention, of an industrial model, or design, of a trade or commercial mark, in one of the contracting States, shall enjoy for the purpose of making the deposit in the other States, and under reserve of the rights of third parties, a right of priority during the periods hereinafter determined.

"In consequence, the deposit subsequently made in one of the other States of the Union, before the expiration of these periods cannot be invalidated by acts performed in the interval, especially by another deposit, by the publication of the invention or its working by a third party, by the sale of copies of the design or model, by the employment of the mark.

"The periods of priority above mentioned shall be six months for patents of invention and three months for designs or industrial models, as well as for trade or commercial marks. They shall be augmented by one month for countries beyond the seas."

Now, as long as Section 4,887 of the Revised Statutes limited the duration of the American patent by that of the foreign prior patent which had the shortest term, it was almost always impossible to make use of the privilege granted by this article of the convention, since the duration of the examination in the Patent Office generally exceeded the seven months of priority allowed and our citizen; if he took out his patent abroad before the examination was completed, it would limit his United States patent to the term of the foreign patent, and thereby forfeit a portion of the term of his United States patent. This has been done away with by the amendment to Section 4,887, Revised Statutes, repealing the limitation. The amendment will take effect January 1, 1898. But the amendment has not done away with the difficulty that the specification attached to the application filed in the United States Patent Office is rarely the same as the specification allowed. It is desirable, therefore, that the convention be so amended as to provide for the case of an amended application.

Being asked whether reciprocity had any place in the convention, Mr. Forbes said:

The convention grants to us an exception to the laws of France, Great Britain, etc., corresponding to our laws. We allow the greatest publicity for a period before patenting. The European countries do not. The patent there is granted for something secret at the time of application.

He hoped that the convention would extend the rights of our citizens still further and do away with the tax and requirement of "working" in the country of the patent, thus making the patent as free abroad to our citizens as it is here to their citizens. The tax in Great Britain amounts to the great sum of £99, and in France to 1,500 francs, payable in each country in installments it is true, but is, nevertheless, a burden to our citizens and in no way reciprocal.

Further reciprocity should allow our citizens to obtain patents abroad for whatever is patentable here to their citizens. For example, articles of chemical manufacture which are patentable here to German citizens and are not patentable to them at home. This works a great injury to us, since it makes the price of patented chemicals much greater here than elsewhere. In the case of artificial alizarine, for example, the price was dropped from $1.60 to 60 cents a pound on the United States patent being declared invalid, and as there was an importation of 750,000 pounds a year, as appears from the customs returns, we granted a privilege to German citizens of such value as to make the subject worthy of consideration in its international relations.

ELECTROLYTIC COPPER REFINING.

The product of the great Anaconda mine in Montana last year was: Copper, $13,003,955; silver, $3,081,552, and gold, $382,259, on which the profit was $5,136,048, and dividends, $3,000,000. President Haggin says that the cost of refining will be next year so reduced as to offset to some extent the fall in silver.

THE STOCK MARKET

A STEADY MARKET.

The past week has seen a steady maintenance of values and in several instances a rise above last week's quotations. General Electric sold to the extent of 70,920 shares, reaching as high as 41⅛, but falling back to 39. Western Union touched 96¾. on sales of 42,541 shares. The local illuminating properties are also participating in the benefits of returning confidence, New York Edison selling at 131 and Brooklyn Edison at 117. Both companies show substantial increase in earnings during the year.

Electrolytic copper is quoted at 10⅞ to 11⅛ cents; casting stock, 10½ to 10⅞ cents, with prices steady.

LEGAL NOTES

BURSTING OF A FLYWHEEL IN ALBANY RAILWAY POWER HOUSE.

A flywheel, 20 feet in diameter, weighing 50,000 pounds, forming part of one of the steam engines operated by the Albany Railway, in its power house in the city of Albany, burst about a year ago, and some of the fragments, flying through the west side of the power house, across the street, and into a saloon, struck and killed a man named John Piehl. In an action by Maggie Piehl as administratrix, against the Albany Railway for damages, it appeared that an engineer, employed in the power house in which were two engines working in multiple and used to generate electricity, upon noticing a violent sparking at the generator connected with one of the engines, and ascertaining that that engine was carrying much the heavier load, instead of first shutting off steam to stop the operation of the engine, broke the current instantly in order to stop the trouble at the generator—in the belief that the automatic governor of the engine would prevent it from running dangerously fast until he should have time to reach the throttle, which was distant only 24 feet—and that he then immediately shut off steam from this engine, and, while passing to the second engine, the flywheel of the first burst from centrifugal force. Judgment given below in favor of the plaintiff was reversed by the Third Appellate Division, which held, in an opinion by Justice Landon, that the evidence was not, even upon the assumption that the engineer made a mistake in breaking the circuit, before he shut off steam, sufficient proof of negligence to charge his employer with responsibility for the death of the intestate, it appearing that the engineer acted promptly in the premises and used his best judgment.

COLLISION OF A CART WITH A TROLLEY CAR.

On the trial of an action brought by James Murphy against the Nassau Electric Railroad Co., of Brooklyn, for an injury caused by the collision of a cart with one of the defendant's electric street cars, the evidence tended to show that plaintiff, the driver of the cart, proceeding eastward, was obliged by the presence of another cart between his own and the curb to drive upon the eastbound track of defendant's street railroad; that after having thus proceeded for some distance the motorman of an eastbound car approaching from the rear signaled him to get off that track; that the position of the other cart being still such as to prevent his turning to the east, he then drove upon the westbound track; that after he had followed this about 100 feet and at a time when still another car on the eastbound track was not far behind his position, he saw, while at a distance from it of from 100 to 200 feet, a westbound car, which had come around a corner, approaching rapidly; that he then turned to go back into the eastbound track, but failed to clear, and was struck and injured by the westbound car. The jury found that there was no danger when the plaintiff turned upon the westbound track; that he did not go into a position of danger; that the necessity of continuing on the westbound track was not removed when he attempted to turn from the west to the eastbound track, and that the car was at such a distance from the cart as to make it safe for the plaintiff to be upon the westbound track. The Second Appellate Division unanimously affirmed judgment given in favor of the plaintiff, holding, by Presiding Justice Goodrich, that the driver of the cart was not guilty of contributory negligence, and that, in turning upon the westbound track, he did not voluntarily and unnecessarily place himself in a position of danger.

REPORTS OF COMPANIES

UNION TRACTION CO., PHILADELPHIA.

The Union Traction Company, which operates all the street railway lines of Philadelphia, with one exception, held its annual meeting last week. A. J. Cassatt, who was elected a director, declined to serve, and General Manager B. Parsons was chosen in his stead. The report for the year ended June 30, 1897, shows a deficiency of $851,934.

BELL TELEPHONE DIVIDEND.

The directors of the American Bell Telephone Company have declared the regular quarterly dividend of 3 per cent. The dividend is payable October 15, to stockholders of record September 30. This dividend of 3 per cent. will make 15 per cent. paid this year, which is the rate paid since 1894. In that year 16½ per cent. was paid, and in 1893 18 per cent.

ST. LOUIS EDISON CO. SOLD.

The foreclosure sale of the property and plants of the Edison Illuminating Company of St. Louis was held on Sept. 11. The interests represented by $8,000,000 in stocks and bonds were closed out to A. D. Brown of the reorganization committee for $914,000. Joseph T. Brown, second vice-president of the Knickerbocker Trust Company of New York, was present to represent the bondholders and comply with the law requiring a chartered officer of a trust company to conduct a foreclosure sale.

The property sold consists of two lots and a one-story brick building on Gratiot street, purchased for $5,000; the old Thompson-Heisler plant at Seventeenth and Walnut streets, bought for $12,000; 5,930 shares of Missouri Electric stock, bought at $50 a share; the Edison plant on Gratiot street, the municipal plant on Twentieth and Locust streets and poles, wires, conduits and franchises. The sale was the largest of its kind ever conducted in St. Louis and the reorganization was the most speedy and successful on record. The Missouri-Edison Electric Company will be incorporated in a few days, with a capital stock of $4,000,000, to succeed the old concern.

CHLORATE OF POTASH MANUFACTURE AT NIAGARA.

State Comptroller James A. Roberts, Tracy C. Becker, Edward Michael, Henry Koons, of Buffalo; Charles W. Hackett, of Utica; William T. Gibbs and Stanislaus P. Franchot, of Buckingham, Quebec, have organized the National Electrolytic Company, with a capital of $200,000, for the purpose of manufacturing chlorate of potash at Niagara Falls. Their factory will be located on the lands of the Niagara Falls Power Company. They will take 1,000 h. p. at the start, but have an option on an additional 1,000. This factory is said to be one of the results of the new tariff, and it is certain that if any city should benefit by an industrial revival, Niagara Falls is that place. The officers of the company are: President, Edward Michael; secretary, Henry Koons; treasurer, Tracy C. Becker. Franchot and Becker were experimenting for a long time in a small building on the Power Company's land, and the organization of this company is practically an announcement that their process is a success. Chlorate of potash is made from a salt imported from Stassfurt, Germany. To the trade this salt is known as muriate of potash, the correct name being chlorate of potash. As the cost of production is expected to be much less by electrolysis than by the chemical process, the United States offers splendid inducements to the new industry, as heretofore all the chlorate of potash used in this country has been imported. Last year this is said to have amounted to about 5,500,000 pounds. The site selected for the plant has not yet been announced, but it is expected that work will begin on its erection at once.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPTEMBER 14, 1897.

Alarms and Signals:—

ELECTRICAL SIGNALING DEVICE FOR USE ON PNEUMATIC CONVEYOR TUBES. G. W. Hook, London, England, 589,832. Filed Feb. 1, 1897.

The moving receptacle contacts with a trigger operating to close the signal circuit.

BELL. S. Jevons and W. Collins, Birmingham, England, 589,897. Filed Oct. 28, 1896.

Employs two different toned bells, two armatures and a hammer placed between them and means whereby the hammer may be made to ring either or both bells.

Batteries, Secondary:—

SECONDARY BATTERY. H. W. Headland, London, England, 589,830. Filed Feb. 11, 1896.

A support for the active material consisting of a series of superposed open frames of polygonal form interconnected at their exterior and interior angles.

METHOD OF MANUFACTURING ELECTRODES FOR SECONDARY BATTERIES. H. Leitner, Niederschönhausen, Germany, 589,842. Filed Jan. 23, 1896.

Mixes with the lead oxide, carbon and glycerine, forms into plates and reduces electrolytically to porous lead. Finally presses.

SECONDARY BATTERY. G. Hart, Detroit, Mich., 590,151. Filed Jan. 14, 1897.

Consists of two similar sheets of metallic lead, each sheet having half-cells formed by walls integral with the sheet.

Conductors, Conduits and Insulators:—

CONDUCTOR. J. Swinburne, London, England, 590,120. Filed Feb. 11, 1897.

Composed of electrolytically-deposited zinc, compressed to increase its density and tenacity.

Dynamos and Motors:—

COIL FOR ELECTRICAL MACHINES AND METHOD OF MAKING SAME. B. G. Lamme, Pittsburg, Pa., 589,838. Filed April 17, 1897.

Comprises a flat bar with an edgewise bend to form parallel arms and a sidewise bend to separate them from each other, the free ends of the latter being bent to bring them into position for attachment to the commutator segments.

ARMATURE FOR ELECTRICAL GENERATORS AND MOTORS. B. G. Lamme, Pittsburg, Pa., 589,839. Filed July 2, 1897.

Comprises a core provided with slots and a winding comprising an inner long bar and outer short bar at each slot, and end connectors bolted to the projecting ends of the bars.

COIL FOR ELECTRICAL MACHINES. J. P. Mallett, Pittsburg, Pa., 589,845. Filed Feb. 15, 1897.

Comprises two parallel sides of unequal length, the ends being bent so that the corresponding faces of the adjacent portions lie in planes substantially perpendicular to each other.

DYNAMO BRUSH HOLDER. J. A. Marsh, St. Louis, Mo., 589,904. Filed Jan. 9, 1897.

Adjustably constructed and the brush makes its contacts by spring pressure.

MOUNTING FOR COMMUTATORS OF DYNAMO ELECTRIC MACHINES. E. Caemmerer, Chicago, Ill., 590,000. Filed May 13. 1897.

Consists in interposing between the commutator frame and its supporting parts an insulated mounting.

ALTERNATING CURRENT GENERATOR. H. Fairbanks, St. Johnsbury, Vt., 590,098. Filed March 6, 1897.

Details of construction.

Electro-Metallurgy:—

PROCESS OF RECOVERING IRON FROM SCRAP. H. C. Wolterеck, New York, 589,915. Filed Nov. 3, 1896.

Consists in placing the scrap in a heated solution of a caustic alkali, treating it electrolytically and simultaneously injecting into the solution a current of air.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. L. E. Adams, Cleveland, Ohio, 589,996. Filed July 28, 1896.

Electro motor regulating mechanism to move both carbons for separating them.

APPARATUS FOR SUSPENDING, RAISING AND LOWERING ELECTRIC LAMPS. M. R. Warner, Manchester, C. O. Bulock and A. E. McLaughlin, York Haven, Pa. Filed Nov. 16, 1896.

The lamp is carried by a carriage adapted to be moved along a vertically and horizontally extending track.

Miscellaneous:—

ELEVATOR CONTROLLER. M. W. Day, Schenectady, N. Y., 589,891. Filed June 12, 1897.

Comprises contacts for connecting the motor with the source of supply, means for disconnecting the motor and connecting a resistance across the mains, and means for shunting the armature by a portion of the resistance.

ELECTRICAL CIGAR LIGHTER. T. C. Dobbins, Telluride, Col., 589,938. Filed May 11, 1897.

Details of construction.

COMPOSITION FOR MANUFACTURING CALCIUM CARBIDE. R. F. S. Heath, Camden, N. J., 589,967. Filed March 2, 1896.

Consists substantially of quick lime nine parts, carbon four parts and one-quarter ounce of sodium or potassium chloride to the pound of the aforesaid.

ELECTRO-MEDICAL EXERCISING APPARATUS. W. A. Webb, Brooklyn, N. Y., 590,050. Filed June 2, 1897.

Consists of a pair of dumb-bells connected with a pocket battery and induction coil.

ELECTRIC TRAP. G. B. Vaughan, Kirkwood, Mo., 590,121. Filed May 14, 1897.

Comprises a platform which is a conductor of electricity, a casing of non-electric conducting material, a bait receptacle which is a conductor of electricity located in the casing, and an electric circuit which includes a generator, connected with the platform and bait receptacle.

ELECTRIC BATH. J. J. Stanger, Stuttgart, Germany, 590,171. Filed March 6, 1897.

A bath having wooden racks arranged one at each side, electric connections to the racks, bars arranged over bath and a cloth to cover the bars.

Railways and Appliances:—

AUTOMATIC SWITCH FOR SURFACE CONTACT RAILWAYS. E. M. Hewlett, Schenectady, N. Y., 589,893. Filed Jan. 25, 1897.

Comprises a car provided with a storage battery, means for turning the car, and an automatic switch for reversing the battery connections.

SURFACE CONTACT RAILWAY. E. M. Hewlett, Schenectady, N. Y., 589,894. Filed May 27, 1897.

Employs an automatic switch for opening the lead from the battery to one of the contact shoes, and a contact in the roadway for opening the switch.

TROLLEY AND CONDUCTOR FOR ELECTRIC RAILWAYS. T. Von Zweigbergk, Cleveland, Ohio, 590,082. Filed Jan. 30, 1897.

Employs a guide wheel placed to precede the trolley wheel.

TROLLEY WIRE HANGER. J. F. Falkner and R. Campbell, San Antonio, Texas, 590,141. Filed March 8, 1897.

Consists of a rigid jaw having a slight dip to receive the trolley wire and a sliding jaw to hold it in place so arranged that when any part of it is broken the whole will fall to the earth.

TROLLEY GUARD. H. C. Reed, Minneapolis, Minn., 590,166. Filed March 16, 1897.

Comprises a retainer rotatably mounted and having a projecting arm to extend across the trolley and retain the line wire in engagement therewith, and adapted to turn to clear a line support.

Switches, Cut-Outs, Etc.:

SWITCH FOR ELECTRIC CIRCUITS. H. B. Shallenberger, Rochester, Pa., 589,865. Filed May 26, 1897.

Comprises a base provided with stationary terminals, a movable contact member having one end bent to form a bow-spring and means for pivoting the spring end to one of the stationary terminals.

Telephones:—

TELEPHONE EXCHANGE SYSTEM. W. D. Dean, St. Louis, Mo., 590,136. Filed Nov. 3, 1896.

Means to prevent the reinclusion of the magneto-generator with the subscriber's calling apparatus while connection exists between the subscribers.

TELEPHONE SYSTEM. W. W. Dean, St. Louis, Mo., 590,137. Filed Sept. 28, 1896.

Comprises apparatus at the central office for exclusively controlling the operation of the electro magnet whereby its operation by sub-station apparatus is prevented and false signals obviated.

TELEPHONE EXCHANGE SYSTEM. W. W. Dean, St. Louis, Mo., 590,185. Filed July 2, 1897.

Comprises switching mechanism at the central office for including the calling generator in circuit with the signal apparatus at the subscribers' station and disconnecting the generator from line.

TELEPHONE SYSTEM. W. W. Dean, St. Louis, Mo., 590,186. Filed July 12, 1897.

Similar to above.

MARRIED

GOTSHALL—VON RATHGEN.

On Wednesday, September 15, Mr. W. C. Gotshall was married to the Countess Von Rathgen, of Hamburg, Germany, at the home of Dr. Heldenfeld, in the Catskills. Mr. Gotshall will henceforth make his home in New York, having resigned from the Union Depot Railroad Company, of St. Louis, to accept a position with the Metropolitan Traction Company, of New York, where he will have charge of the underground construction of the Second Avenue line, now being converted from horse traction to electric. Mr. Gotshall has made an enviable reputation for himself in St. Louis, and the Metropolitan Company is to be congratulated on acquiring so experienced an engineer for one of its most important lines.

THE WORLD'S TELEGRAPH SYSTEM.

The total length of the world's telegraph system has now reached 4,908,921 miles, exclusive of 180,440 miles of submarine cables. Of this Europe has 1,764,790 miles; Asia, 310,685 miles; Africa, 99,419 miles; Australia, 217,479 miles, and America, 2,516,548 miles. United States Consul Germain, who sends these figures to the State Department from Zurich, says they show that notwithstanding the steady increase in the building of telegraph lines all over Europe, America leads the world and has almost double the European mileage.

THE DIAMOND SHOAL, off Cape Hatteras, will soon be marked by a first class lightship, bearing two powerful masthead electric lights. She will be anchored in thirty fathoms of water. In each lantern will be a 100 c. p. incandescent lamp, 57 feet above the water, and visible a distance of thirteen miles.

TRADE NOTES & NOVELTIES

10,000 VOLT HIGH POTENTIAL TESTING TRANSFORMER.

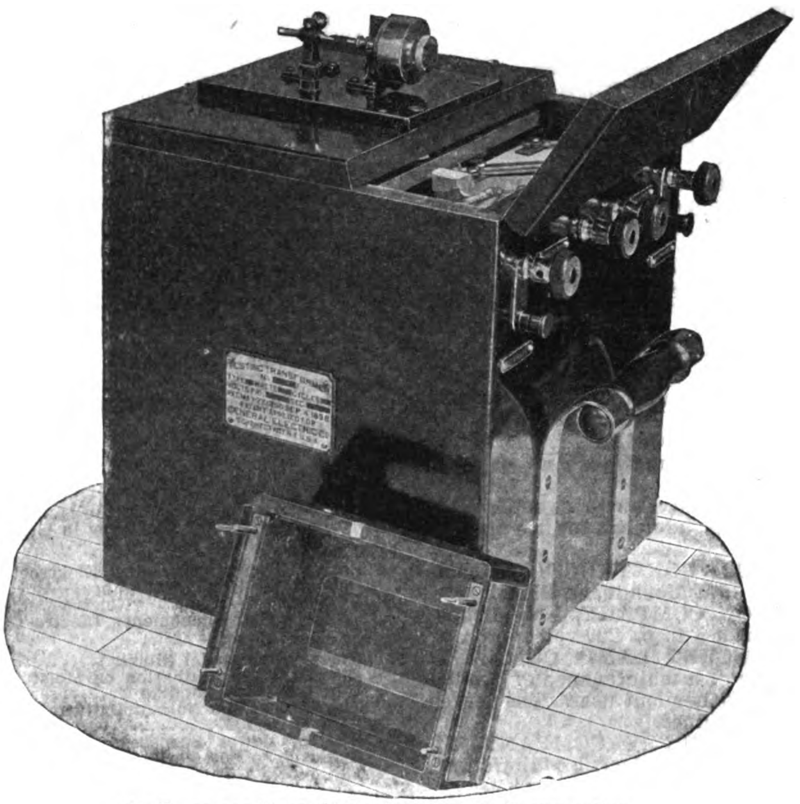
IT is a well known fact that electrical apparatus may show high insulation resistance when tested in the usual manner at low voltages and yet may be easily damaged by the application of a few thousand volts potential. A thin film of air will show almost infinite resistance when measured with a galvanometer, but it offers practically no resistance to the path of a high tension current. For this reason when determining the security of apparatus, such as the secondary of a lighting transformer, against high potential charges from the primary circuit, it becomes necessary to test by the direct application of high potential across the insulations to be measured.

For this purpose the General Electric Company has developed the 10,000 volt high potential testing transformer, illustrated in the accompanying engraving, which consists of a small transformer wound on a rectangular core similar in construction to that of the "type H." The low tension circuit is wound on one branch of the core and on the other branch the primary coils are placed. There are four primary coils, each wound and insulated independently, the four coils being assembled on a sleeve of heavy insulating material. After assembling, each transformer is tested to a maximum strain of 35,000 volts between the high and low potential windings, thus insuring safety from accident. By means of a porcelain series multiple connection board the apparatus can be used on either 52 or 104 volt circuits. The transformer itself is immersed in oil.

On the top of the apparatus is a box with a glass window, enclosing a micrometer spark gap arranged as a shunt across the high potential terminals. This box or cover carries four long contact studs fitting into sockets in the transformer box. The lifting of this cover for the purpose of adjusting the spark gap entirely disconnects the spark gap from the high potential circuit. On one side of the transformer case are six terminals, two for the main circuit, two for the adjusting rheostat, in series with the low potential circuit, and two small terminals providing connections for a voltmeter permanently across the low potential circuit of the transformer. The transformer case is mahogony, the trimmings of nickeled brass and polished hard rubber. The case is provided with two handles for transportation; also with a stop-cock for drawing off the oil when necessary. Provision is made for readily polishing and readjusting the points for the spark gap.

When using the apparatus the spark gap is first set to discharge at the limit of voltage desired, readily done either by the use of a calibration curve or by a voltmeter on the low potential circuit, the ratio of transformation being known. Having adjusted the spark gap, the apparatus under test is connected to the high potential terminals on the spark gap base and the potential again brought up to the amount desired and held as long as necessary. The apparatus under test is thus connected in multiple with the spark gap, and the accidental application of higher voltage than was intended will merely result in the formation of an arc across the spark gap short circuiting the apparatus under test and protecting it from damage. The transformer is designed to run on either 60 or 125 cycle circuits and to deliver up to 10,000 volts at a normal current of .05 ampere in the high potential circuit. This can, however, be exceeded for shorter periods.

The rheostat used to control the voltage on the low potential side may be of any convenient type. A small rheostat of portable form for this purpose has also been developed by the General Electric Company. This consists of a vertical tube and stand with a fixed contact plate at the bottom and another plate attached to a sliding rod, the rheostat being filled with water, to which a small quantity of salt or soda has been added.



G. E. 10,000-VOLT HIGH POTENTIAL TESTING SET.

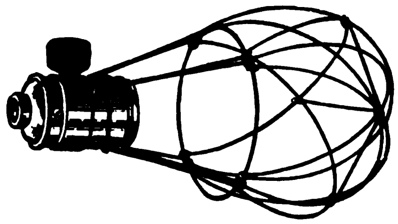
"THE BOOK OF THE ROYAL BLUE."

Among the many advertising novelties soon to be issued by the B. & O. is one which is sure to attract a very considerable amount of attention. It is to be known as "The Book of the Royal Blue," and is to be issued monthly by Colonel D. B. Martin, manager of passenger traffic. Of magazine size and filled with attractive half-tone illustrations, and good reading matter, "The Book of the Royal Blue" is bound to make a hit. One splendid feature is a list of names and address of every passenger and freight agent.

F. R. HARRIS, of 25 Benedict street, Waterbury, Conn., manufactures a special alloy wire for rheostats and resistance wire for all purposes. He makes a specialty also of spring wire and all kinds of brass, German silver, phosphor bronze and copper wire.

THE WAGOR WIRE LAMP GUARDS.

INCANDESCENT lamps are frequently placed in positions where they are liable to be broken, and thus a guard of some kind is essential to the life of the lamp. Messrs. P. R. Wagor & Co., of 275-279 Main street, Springfield, Mass., devote special attention to the manufacture of wire lamp guards, one form of which is illustrated in the accompanying engraving. They make a variety of guards in tinned wire and polished brass, suited to different situations, a special feature of which is their new wire holder, which permits of the guard being easily and firmly attached to the lamp socket.



THE WAGOR WIRE LAMP GUARD.

Messrs. Wagor & Co. also manufacture all kinds of lamp shade holders, fancy frames for silk and crepe tissue shades, florists' wire designs, window dressers' specialties, etc.

ADVERTISERS' HINTS

F. R. HARRIS, 35 Benedict street, Waterbury, Conn., manufactures spring, electric, brass, copper, German silver and phosphor bronze wire. Also special alloy wire drawn to order.

P. R. WAGOR & CO., 273 Main street, Springfield, Mass., advertise wire lamp guards and guards made to order for special purposes. Their catalogue "A" contains full information.

C. J. ROOT, Bristol, Conn., manufacturer of weighing, measuring and automatic machines, calls attention to the "Bristol" counting machine for recording accurately the work done on foot and power presses.

THE W. H. ELLIOTT ELECTRIC COMPANY, Cleveland, Ohio, make a specialty of repairing armatures and pay the freight on those sent them.

EDWARDS & CO., 144th street and Fourth avenue, New York, call attention to their single stroke gongs for fire alarms, railroads, schools, mines, etc.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY'S Chicago office is now at 1511 Monadnock Block.

THE METALLIC INSULATION COMPANY, New Brunswick, N. J., are in the market for a 5 h. p., 220-volt motor.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., publish the curves of a maintenance of candle-power test of their lamps by an independent user. The curves are practically straight, horizontal lines.

THE WESTERN ELECTRIC SUPPLY COMPANY, St. Louis, Mo., are representing the Stanley Electric Manufacturing Company.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, 114 William street, Newark, N. J., have just brought out a profusely illustrated catalogue of their excellent apparatus.

THE ARMITAGE HERSCHELL COMPANY, North Tonawanda, N. Y., say the "Niagara" freight and passenger elevator will meet the most exacting conditions of speed, load and rise on either direct, alternating or phase circuits.

NEW YORK NOTES.

MR. DAVID CHALMERS, 112 Liberty street, has taken the agency for the Cutler-Hammer Manufacturing Company, of Chicago, who manufacture rheostats, starting boxes, etc. Mr. Chalmers will carry a full line of these goods in stock.

THE WARD-LEONARD ELECTRIC COMPANY, of Hoboken, N. J., will move into their new factory, at Bronxville, N. Y., this week, where they will have much larger facilities for manufacturing rheostats, theater dimmers and electric heating apparatus. Their business is rapidly growing.

JOHN A. ROEBLING'S SONS' COMPANY, of Trenton, N. J., report business as improving with much more rapidity than they had looked for, and say large orders for wires and cables are being booked every day.

WESTERN NOTES

THE PURITAN ELECTRIC COMPANY, of New York and Boston, have appointed Mr. George Walker Conover, their agent for Chicago and vicinity, with headquarters at 1511 Monadnock Block, Chicago. Mr. Conover is well known to the electrical trade, and should be a valuable acquisition to the Puritan Company, who are decidedly feeling the effects of better times and are kept busy supplying the increasing demand for their alternating enclosed arc lamp.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. SEPTEMBER 30, 1897. No. 491.

ELECTRIC LIGHTING

THE ELECTRIC LIGHTING SYSTEM OF ROCHESTER, N. Y.

BY GEORGE B. MULDAUR.

The electric lighting of Rochester, N. Y., represents a gradual and healthy growth from the time when the first station was hung over the side of the gorge of the upper Genessee Falls, fifteen years ago until now, when the city boasts no fewer than five stations and is one of the best lighted towns in the United States. Two independent companies, working together, and in fact having the same officers, have accomplished the work and are to be congratulated upon the creditable result. The Brush Electric Light Company operates the arc light station at the Lower Falls, while the others are owned by the Rochester Gas & Electric Company. They are all tied together, as hereafter explained, in order that each may help the others in case of emergency. There are no "districts," but the current from all stations is sent where it will do most good and distributed according to the demand.

As a general rule water power is employed, and its utilization has led to the solving of some notable problems in station building, but steam is held in reserve in case the river falls too far below the normal, and the change over from one power to the other can be made without loss of time.

For the purposes of description the plants of both companies will be considered together. To all intents and purposes, except in the matter of finance, they are one, and the whole electric system is under the efficient superintendence of Mr. George A. Redman, to whom I am indebted for the data from which this article was compiled.

For convenience sake the stations are numbered from one to five. No. 1 is the exception which proves the rule regarding water power. An interior view of this station is shown in Fig. 1. It is situated on Edison street near the centre of the commercial quarter, and close to the canal at the point where the latter crosses the river. It is a small, unpretentious, two-story brick building, and is the only one of the generating stations operated wholly by steam. It is held in reserve and only used in seasons of low water or in case of an accident occurring to stations two or four. The dynamo room contains two Thomson-Houston arc, two No. 8 Brush and six pair 100-k. w. Edison bipolar generators. The Edison distributing board carries two sets of bus-bars and a separate arc light board is provided for the Thomson-Houston machines.

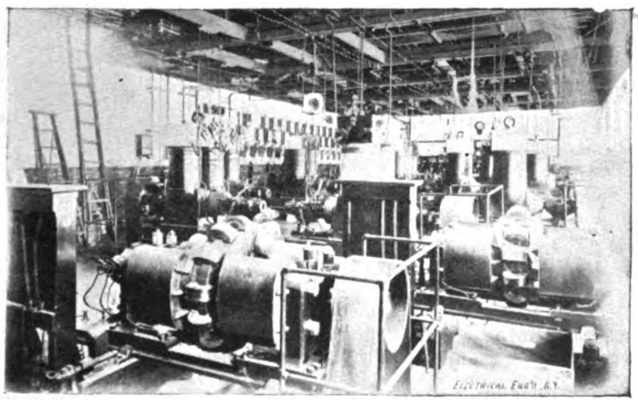


FIG. 1.—DYNAMO ROOM, NO. 1 STATION.

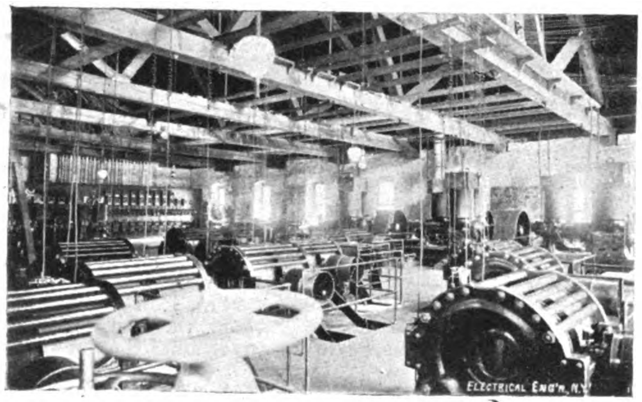


FIG. 3.—DYNAMO ROOM, NO. 2 STATION.

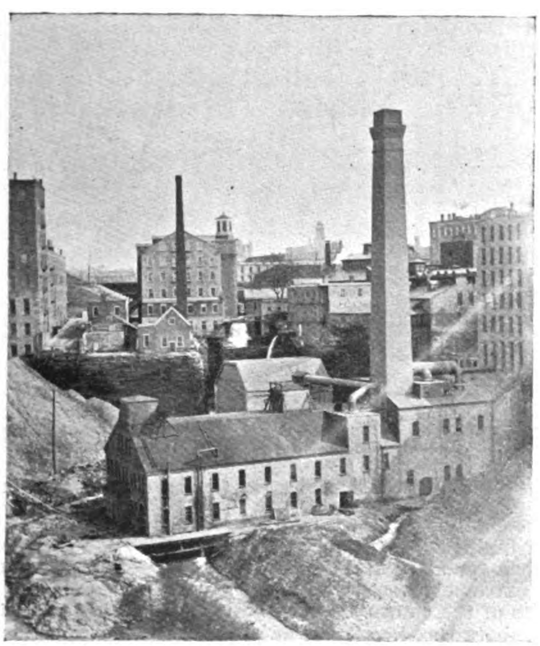


FIG. 2.— NO. 2 STATION, UPPER GENESSEE FALLS.

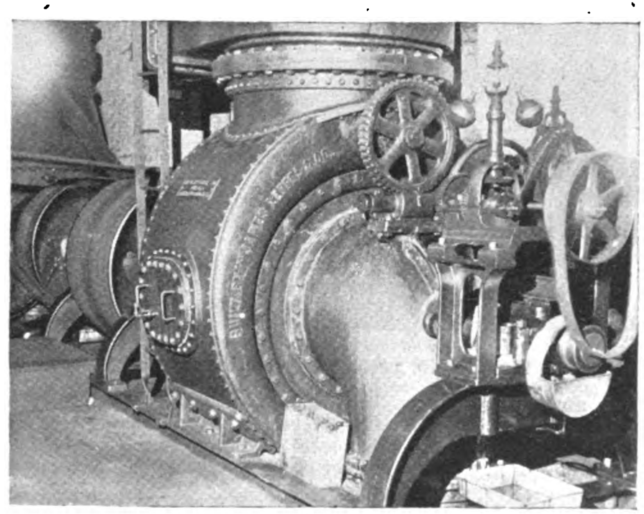


FIG. 4.—TURBINE AND GOVERNOR IN NO. 2 STATION.

Each pair of dynamos is belted direct to an engine in the basement. The full equipment includes three Armington & Sims, three Woodbury and two Porter-Allen engines, each of 150 horse power. Water for condensing purposes is taken from the mill race, twenty-five feet away, and power is supplied by eight 150 h. p. Woodbury boilers.

No. 2 station is the largest of all. It stands in the bottom of the gorge below the Upper Falls on the left bank of the river, and is approached through a passage beginning at

Brown's Race on the street level and ending at the dynamo room seventy-five feet below. A good part of the approach is cut out of the solid rock. Elsewhere masonry is added to the rock walls and the whole effect is not unlike that of the entrance to a mine. A long flight of wooden steps, with frequent landings, lighted at intervals by hanging incandescent lamps, leads down apparently into the bowels of the earth, and it is with a feeling of pleasure and surprise that one comes out at the bottom into the fine, light and airy dynamo room.

This is a combination station, equipped with both turbines and engines, though the latter are chiefly held in reserve. The penstock is six feet in diameter and 200 feet long and comes down the rock passage already referred to. The water

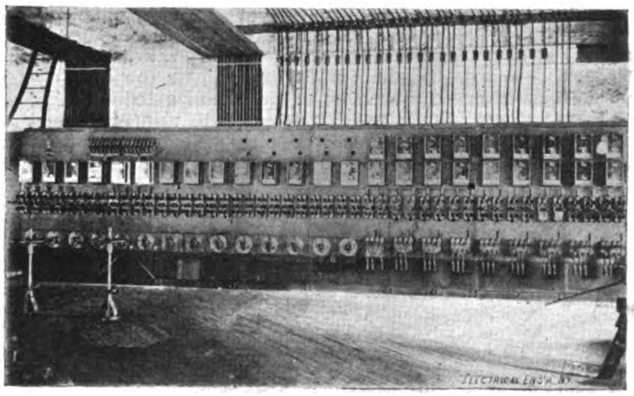


Fig. 5.—Switchboard, No. 2 Station.

is taken from Brown's Race and the head is 88 feet 6 inches. The pressure on the penstock is shown by a gauge in the dynamo room. Beside the penstock is an iron chute leading from the upper earth to the boiler room, through which coal is brought down and stored in a cavernous rock-hewn bin against the hour of need.

The station proper, shown in Fig. 2, is a solidly built structure of stone, with a wooden truss roof surmounted by two cable towers. It is 175 feet long by 90 feet wide and 55 feet in height. The dynamo room, Fig. 3, occupies the second floor and contains sixteen Thomson-Houston arc machines, ten 150

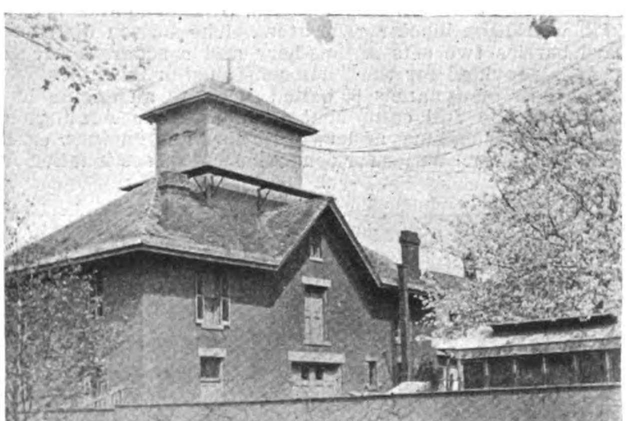


Fig. 6.—No. 3 Sub-Station, Dryer Alley.

k. w. and six 100 k. w. Edison bipolar generators, run from turbines and engines in the basement. The former are built by the James Leffel & Co., and are five in number of 500 h. p. each. Fig. 4 shows one of the turbines with its governing device.

The steam auxiliary consists of one Armington & Sims, three McIntosh & Seymour and three Contis engines, each of 450 h. p., and seven Hazleton vertical boilers, aggregating 3,500 h. p.

The distribution of power is as follows: Three pair of the 150 k. w. generators are driven by three of the engines. The other pair and one pair of 100 k. w. are belted direct to turbines. A second pair of 100 k. w. are belted to the line shaft in the basement run from the engines. The third pair of 100 k. w. and the arc light machines are belted to shafting which may be driven by engines or turbines as circumstances require, and may be run all together or separately.

A noticeable feature of this station is the handsome and eminently serviceable switchboard, Fig. 5. It is of slate, 42 feet long by 8 feet high, and was built by the company. Besides the feeders and ammeters shown in the figure there are two Bristol recording voltmeters, four General Electric

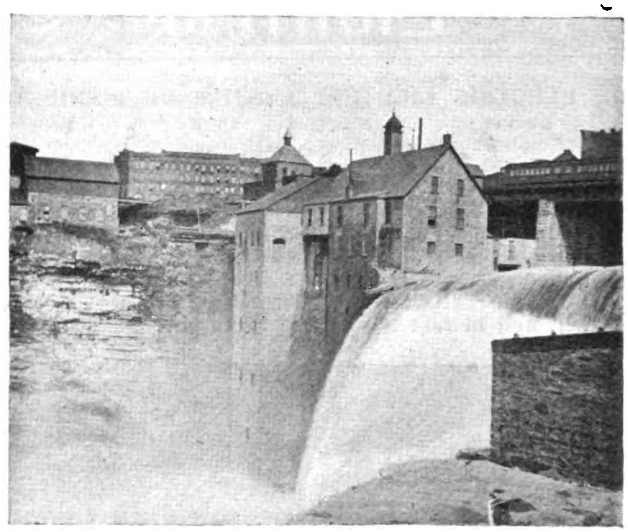


Fig 7.—No. 4 Station, Upper Genessee Falls.

galvanometers and switches and four sets of pressure indicators. Four bus-bars are provided that current may be run at as many pressures.

Station No. 3 is merely a distributing centre. It is a neat, brick building, Fig. 6, situated in Dryer Alley, near Union street, in the residential "East End" portion of the city. This, by the way, corresponds to the "West End" of nearly every other town. The course of empire in Rochester, contrary to all precedent, is taking its way eastward—has done so, in fact—and, although some of the old residents still cling to their

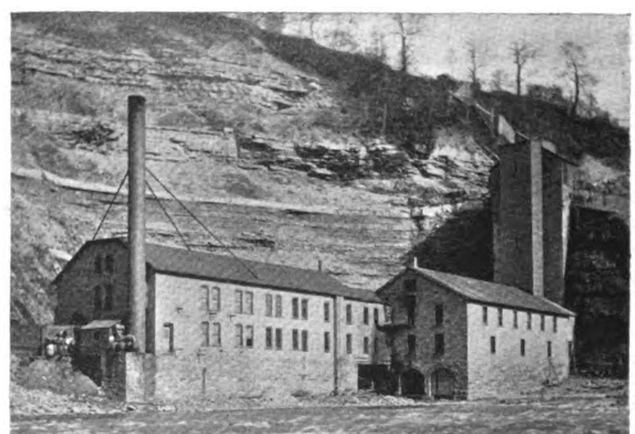


Fig. 8.—Brush Station, Lower Genessee Falls.

homes down town, so many people of position and wealth have builded in the east that that section has become a proverb for all that is great and good. As a matter of fact, it is extremely beautiful, and East avenue is one of the show streets of the country. The station is provided simply with a switchboard and a set of lightning arresters for the wires of the Edison system. No attendance is required and the building is kept locked and merely inspected from time to time.

STATION NO. 4.

The first lighting station built in Rochester is that now known as Station No. 4. It is fifteen years old and stands directly on the edge of the Upper Falls at the east side of the river. Fig. 7 gives one a good idea of its surroundings and

structural peculiarities. The original wheel pit, which is still used, is blasted out of the solid rock from the ledge at the top of the falls to the level of the river below. During the past year a new pit has been added, but this is built of brick at the edge of the gorge and a little further from the fall. It may be seen at the left of Fig. 7. A 94-foot head is obtained with these pits, which are themselves ninety-eight feet in depth. The dynamo room is at the street level and contains five Western Electric, one Brush, two 100 k. w. and six 150 k. w. Edison bipolar generators, all run by belts from a countershaft below the floor, which in turn is directly belted to the turbines at the foot of the pits. These are Leffel wheels, five in number, aggregating 2,700 h. p. There is no auxiliary apparatus in the station proper, but across Central Avenue, fully 200 feet away, in a building owned by the company, are three Woodbury boilers and one 500 h. p. Fishkill Corliss engine, only used at seasons of unusually low water. Power from this engine is transmitted to the generators by means of a six-inch shaft extending under the street. Judging from the condition of the falls shown in Fig. 7 one naturally assumes that there is apt to be no lack of water on porcelain insulators and are spaced at a generous distance apart to admit of easy access.

The dynamo room in this station is a marvel of compactness. Every inch of available space is utilized, yet there is no crowding. A glance at Fig. 11 shows the arrangement of generators, instruments and switchboard. The room includes the entire upper floor of the station proper—a stone building 85 feet long by 45 feet in width—and contains 32 Brush arc dynamos, two 124 k. w., 500 volt Brush, one 90 k. w., 500 volt Thomson-Houston, and two 1,040 volt 1300 light Thomson-Houston alternators. These are all belted to shafts in the room below and are run by means of one Leffel and fifteen Lisner turbines, with a total capacity of 4,500 horse power.

There are three five-foot iron penstocks, 88 1-2 feet long, fed by a race at the top of the falls. The race is thirty feet wide, about 130 feet long, and six feet deep, so that the total head is about ninety-four feet. The head gate structure is of heavy masonry and the gates are of oak.

From the turbines are run sixteen shafts, arranged in parallel lines in a room directly below the dynamo room and of the same dimensions. As a reserve there is provided one Cooper-

Fig. 9.—Views of Conduit and Manhole Construction, Rochester, N. Y.

power and that steam auxiliaries must be at a discount; yet there are times during the summer when, as was the case during the early part of July this year, the various manufactories clustered about the falls absorb literally all the water in the river, leaving the rocky ledge absolutely dusty. Hence it is just as well to have an engine or two at hand, and the boilers also supply steam during the winter for heating the station.

There is a Western Electric switchboard for the arc machines and an Edison board for the three-wire system. The necessary indicators and test instruments are of Western Electric and General Electric manufacture.

The Brush Company's station stands at the foot of the gorge below the Lower Falls of the Genesee, two and a half miles from the business part of the city, and 214 feet below the grade of the street, Fig. 8. It is reached by half a mile of road along the bank of the river, or a winding stair, to the platform at the top of the falls, and thence by an elevator of fourteen tons capacity. The well in which the elevator runs is also the cable tower, space having been provided for that purpose on both sides of the shaft. The cables are all carried Corliss 550 h. p. engine, with four boilers of the same make. The engine and boiler rooms are in the rear of the building shown at the left of the station, Fig. 8. They are used very little—hardly ten days in each year—as there is nearly always enough water at this point to supply the turbines.

As already stated, the district system is not used in Rochester, but the stations are so arranged as to work together, or independently, as circumstances require. Stations Nos. 1, 2 and 4 work into the Edison three-wire system so that in case of accident to any one of them the others can carry the whole load. All stations are tied together with extra arc loops and any one can take part of the load from any other. In case of repairs any station can be wholly shut off and the work done by others. All the lighter exterior wiring is carried overhead except some fourteen circuits lighting the southern part of the city. These cross Main street in a subway. Nearly all the high tension arc lamps are hung on cranes or stationary mast arms. Movable arms are being dispensed with altogether. The low tension street arcs from the Edison system are hung in pairs from ornamental iron posts and the conductors are carried underground in conduits.

The subway is of home manufacture. It is built of three-inch vitrified pipe, made by the Standard Sewer Pipe Company, of Rochester, and has been found to answer the purpose admirably. At present the system extends on Main street from the Erie Canal to University avenue, with a bunch of eighteen ducts on each side of the street; State street, from Main street to Lake avenue, twelve ducts on each side; Exchange street has eight ducts on each side from the canal to Main street; St. Paul, ten ducts on each side from Central avenue to Court street; Central avenue from St. Paul to the river has a similar number; West avenue from the Canal to Madison street, six; Exchange street from the Canal to Adams street, six; Mill street from Exchange Place to Central avenue, four, and Lyell avenue from Moulson street to Lake, four. In all there are 459,000 feet of duct distributed over about eight miles of street. Access is had to the subway by means of 264 standard manholes and 240 subsidiaries. See Fig. 9.

About 450 miles of overhead wire is carried on cedar poles. In addition to this the Brush Company has 320 miles of overhead wire and four miles in subways.

THE LIGHTS.

On the ornamental lamp posts already referred to and shown in Fig. 10 are 350 low tension arc lamps hung in pairs and supplied with current from the Edison three-wire system. Altogether there are 1,272 arcs in the Edison circuit and about 45,000 16 c. p. incandescents. There are also at present 476 motors, aggregating 1,937 h. p., and the demand is rapidly increasing. Of high tension arcs from the Thomson-Houston and Western Electric circuits there are 1,046, while on the Brush Company's circuits are 1,422 arcs and 531 motors of 484 h. p.

THE COMPANIES.

The Brush Electric Light Company has been in continuous operation since its organization in 1881. The Rochester Gas and Electric Company is of more recent formation, having been organized in 1892 by a consolidation of the Rochester Gas Company, the Edison Electric Light Company and the

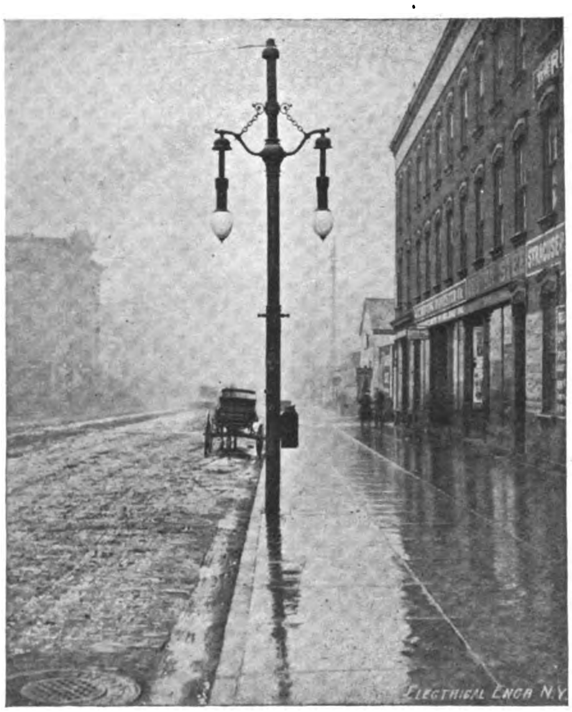


FIG. 10.—STANDARD ARC LAMP POST, ROCHESTER, N. Y.

Rochester Electric Company. While the two are wholly distinct, a glance at the list of officers of each shows that a certain harmony may be expected to exist between them. The officers of the Rochester Gas and Electric Company are J. Lee Judson, president; George W. Archer, treasurer; W. L. Cole, secretary; George A. Redman, superintendent of electrical department. Those of the Brush Company are George W. Archer, president; J. Lee Judson, treasurer; W. L. Cole, secretary; George A. Redman, superintendent.

Both companies occupy a fine large office building on Mumford street. It is a two-story castellated brick structure, 75 feet wide and 35 feet deep, extending from Andrews street to the river. In the rear are the test and lamp repair rooms in a one-story building 25 by 40 feet. Back of this is another single story building, 25 feet wide by 125 feet in length, used as a store room. Club rooms, locker rooms and waiting rooms for the employés are provided in a two-story building, part of which is also occupied by the motor room. Next comes the underground department, one story high and 40 by 45 feet in area. There the work shop and heavy material store room, 25 by 75 feet, is located. Behind this is the blacksmith shop and a stable with twenty-six stalls and the remainder of the property is occupied by a store yard, 300 feet long by 200 feet wide, in which are kept pipe, poles, etc.

CONCLUSION.

These two companies, by their progressive policy, hard work and executive skill, have built up an electric system keeping step with the progress of their city and in full accord with its

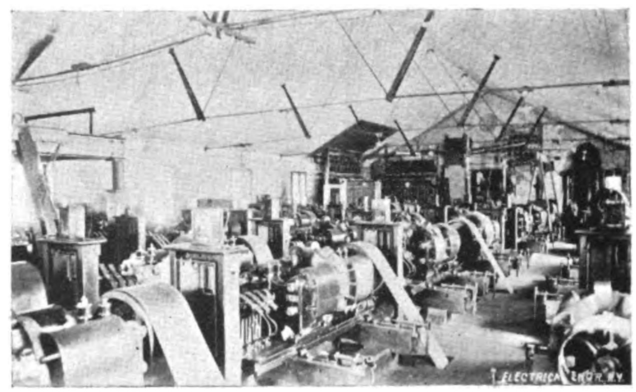


FIG. 11—DYNAMO ROOM, BRUSH STATION.

spirit of solid, healthy growth. The demand for current for public lighting increases, of course, as new streets are laid out and houses are built upon them, but the commercial lighting account is directly dependent upon the progressiveness and prosperity of the public. It is gratifying to record, therefore, that this demand has necessitated the addition of four new generators in two of the stations within the past few weeks. The use of motors, large and small, in various classes of business is also increasing rapidly. Both companies may congratulate themselves on the excellent showing they have made during the long period of financial depression and both have been quick to feel the bettered conditions which now exist. Alterations, additions and improvements are already being made in their stations and apparatus, and the force is kept busy night and day.

ARC LAMPS AND THEIR MECHANISM.—I.

BY H. FRANKLIN WATTS.

IT is seldom found in the history of invention that the first production of a machine or process is really superior to subsequent improvements. The truth of this saying is found in the development of the steam engine and dynamo-machine, the printing press and a thousand other things, all of which are now the result of a process of evolution up to the present state of their mechanical perfection.

If we rate the value of a machine by the simplicity and fewness of its parts while filling its proper function, we can truly say that the original Brush lamp of 1879, ungainly and cumbersome, was, nevertheless, in point of simplicity, superior to 95 per cent. of all the arc lamps that have since been brought out. These alleged improvements have nearly always been in the direction of ingenious complications in the embodiment of a certain principle. To the embryo inventor it made no difference what means or complexities were necessary so long as the lamp carried out his pet principle. This accomplished, the lamp was perfection and his fame and fortune were at once assured. Many inventors never appear to see but one side of their scheme, and that while a certain scientific principle may be of great value in a lamp or machine, the means necessary to carry out that principle might outweigh all its good points 10 to 1. Hundreds of schemes theoretically perfect are found in practice difficult to apply.

In the designing of an arc lamp, a locomotive, a threshing machine or a hay rack we should be ever mindful that "simplicity is the mark of a great invention." To invent a successful machine requires genius, to improve it greater genius, but the man who can take from it some of its parts while

fulfilling its purpose or increasing its capacity or efficiency is indeed a genius of no mean order. Such a person would do well to study arc lamp mechanism, for I verily believe that the best lamps now built are not good enough and that the near future will bring out a lamp or lamps the number of whose parts will be reduced to an extent hitherto unknown.

The efforts of inventors have been mainly directed toward obtaining a slow and steady downward movement of the carbon rod, the rack and pinion being most common in connection with some form of escapement. These lamps when in good condition give a very steady light and will often feed in drops of a single volt at a time and leaving in the matter of steadiness nothing to be desired. These lamps are especially adapted for indoor use and for incandescent circuits, on which case, if we err at all, we should err on the right side—that is, we should so construct our lamp that in case of trouble the carbons will stick and fail to feed rather than to allow the carbons to slip by and fail to lift and thus burn out the lamp. On series circuits the opposite holds true; that is, it is better for the carbons in feeding to drop like a ton of lead rather than to stick and fail to feed altogether. This is the trouble with the rack and pinion lamps; they are not adapted to outdoor service or rough usage and being geared high are apt to stick, and the chances are that the lamp has a poor cut-out, which will operate only a limited number of times, or until the contacts become blistered and then the entire stomach has to be renewed.

The "clutch" lamp, on the other hand, gives a better all around satisfaction and several concerns who for years confined themselves entirely to the "clock work" lamp, have quietly adopted the clutch.

It is true that these lamps are very apt to "drop" in feeding, yet if they are able to recover promptly the blink in the light is hardly noticeable, especially if two or more are burning near by. It is even more important that a lamp be able to recover promptly from over feeding, than it is for it to have a first-class clutch. I use the term "first-class" in a popular and not a scientific sense and refer to a clutch that will allow the carbon rod to slide slowly and steadily by invisible increments and not drop the rod like a trip hammer every time the lamp is hungry and desires to feed.

Consider two distinct cases: First, a lamp having a strictly first-class clutch, but a sluggish and friction-bound mechanism; a lamp in which if you push up the armature of the magnet it will stay up. If you pull it down it will stay down and remain for some time in any position in which you leave it. This represents the common class of lamps as we would find them in most cases. Second case: A lamp having practically no clutch at all, or one in which the rod will drop a full eighth of an inch without fail each and every time it feeds, but having a free and frictionless mechanism—a dash plunger pot fitting quite loosely, but not too much so, a lamp in which if you force up the armature while the lamp is burning, it will promptly come down again, if you pull it down it will come up again—in fact, a lamp in which a certain voltage will always correspond with a certain position of the armature and carbon points. Which of these two classes will give the best results?

In the first case, if the rod is well polished and uniform in diameter, the clutch may for a short time act properly and the lamp burn quite steadily; but the condition under which a rod will just slide through a clutch and no more, is indeed a very delicate one, difficult to obtain and still more difficult to maintain, especially after the rods have reached that condition in which the average trimmer keeps them.

We may, therefore, say that such a lamp will practically go out every time it feeds, dropping its carbon like a hot potato and, owing to the friction of its parts, it is unable to recover and thus the lamp will hiss for fifteen minutes on a stretch. Such a lamp will cause no end of trouble and annoyance if used on commercial circuits.

In the second case the rod will also drop on account of its poor clutch, but having a frictionless mechanism it will instantly recover by lifting the carbon and will then burn quietly and steadily until it is time to feed again, when the same thing will be repeated. This lamp will give fair satisfaction. The perfect condition, however, exists when the good clutch of case 1 is applied to the frictionless mechanism of case 2. I am convinced that there is no clutch in existence that can be depended on to produce the desired effect. There are many forms in use, probably all of which produce the necessary sliding action while on the test rack in the factory; but look at these same lamps six months later. One would often wonder if they are the same lamps. It is just here—between the clutch and the rod where the rub is; they lack staying qualities.

An enormous amount of time and money has been expended on this matter, but I am convinced that a "sneak feed" in a clutch lamp is, in practical work, an impossibility and all attempts in this direction will not amount to a pinch of snuff. Gray matter, time and money can be employed to far better advantage in the elimination of friction from the rods, bushings, etc., and right here I wish to point out that the bulk of the friction in a lamp does not lie in the mechanism proper—the armature pivots, dash pot or clutches, etc.—but between the carbon rods and their guides or bushings, and upon the latter depend the operation of the lamp far more than in the pivots and dash-pot, etc.

The author is familiar with lamps in which the movement is remarkably free from friction, and yet they burn no better than the others on account of dirty rods. Knife edges are all right, but they do not lessen the rod friction. It is not sufficient that this friction be maintained constant in amount, as friction in an arc lamp is exactly what it is in a watch or bicycle—a great evil—and the best lamp, other things being equal, is the lamp in which friction is reduced to the smallest possible quantity.

Mr. T. E. Adams, from whom much is expected, is employing graphite not for the rod bushings of his lamp rods, but for the wearing surfaces of his clutches with the idea of obtaining uniformity in feeding.

The writer is not prepared to say that this is not a great improvement, or that this disposition of the anti-friction material is not the best that could be made in this particular lamp, by reason of the housing which the rods obtain, but I am prepared to say, and also to demonstrate, that in lamps of the ordinary style the rod bushings would be a far better place for the graphite than in the clutches. It would seem that its use in upper and lower bushings of both rods would be of great value and in the clutches, too, it would do no harm.

But while the bulk of friction in a lamp is in the bushings, there are certain lamps in which the friction of the armature pivots is by no means small. A well known lamp having a stiff spring at one end and a powerful magnet at the other end, both pulling down upon the pivots suffers in this respect. Such an arrangement would be very much improved by substituting knife-edges for the steel pins. This, however, would necessitate a new magnet by removing both pierced armature and iron cores and using a "U" shaped plunger similar to the Brush.

It might also be suggested that while the Thomson-Houston bushing is perhaps better than most others, it would be better to use an upper and lower graphite bushing, which, at the same time, makes the sliding contact. It is quite important, too, that these bushings should be readily removable, both upper and lower, which is not the case in the lamp referred to.

In the matter of cut-outs for series lamps, there is also much room for improvement. If we estimate that there are ten fairly good lamps in use I think we can say there are not more than two of these lamps that have even decent cut-outs. A cut-out is to an arc lamp what a commutator is to a dynamo—the ticklish end—the seat of trouble. The author has often been astonished at the make-shift devices used as cut-outs in lamps by men whom we thought knew better. Electrical engineers of high professional standing have designed arc. incandescent and even more difficult railroad generators for 500 volts and a thousand or two amperes and yet they could not design a cut-out to carry ten amperes, but employed two pieces of spring brass or of copper and arranged them to make contact at the proper time. But alas, such a cut-out is no cut-out at all, for while it may operate successfully a few times while on the test rack, it will not be long before it will forget to do so and by the time the inspector arrives there is nothing left worth cutting out. Let us, therefore, have good cut-outs in our lamps, even if we have nothing else.

Regardless of whether it will be considered "wise or otherwise" to mention special apparatus, I cannot refrain from pointing out that I am convinced that for many years past the cut-out used in the Thomson-Rice lamp was in point of merit head and shoulders above them all. I refer not to the cut-out as a whole or the means employed to operate the contacts, but I refer to the material of which these contacts are composed, namely, pure silver.

One of the severest tests of a contact metal that can be imagined is in the controller of the Thomson-Houston arc dynamo, in which a large magnet is cut in and out of circuit fifteen or twenty times a minute ten hours a day, seven days a week for say five years, making more than 21,000,000 makes and breaks, and yet there is seldom any trouble with the contact, in fact there is usually less trouble with this device than any other part of the system. The same device is also used in the lamp. With these machines in extensive use throughout the country, thus bringing the above fact under the very noses of all concerned, electricians will deliberately use brass or copper for cut-outs and then wonder why the lamp burns out. It is gratifying to observe that Mr. Adams has adopted silver for his latest production.

It is supposed by many that the high voltage employed on

arc circuits reduces the difficulty in making a good cut-out contact. It is precisely the reverse. The high voltage increases the difficulty by reason of the current flowing at all times, regardless of whether the contact is arcing or not.

A certain well known lamp uses two flat brass surfaces having an area of about one-fourth of a square inch. They are supposed to come together perfectly flat and true, in which case better results might be expected. But in practice it is found that nine out of ten of these lamps make contact upon the extreme outer edge only, which soon becomes blistered and burned. It would be best to go to the root of the matter, become a Populist and adopt a free silver platform at once.

PLAIN vs. INSULATED IRON CONDUIT.

BY. WM. MAYO VENABLE, INSPECTOR CINCINNATI UNDERWRITERS' ASSOCIATION.

The facetious article by "Jim Crow" in The Engineer of Sept. 9, entitled, "Are Two Safety Factors Better Than One?" is worthy of a reply, not on account of the spirit in which it is written, but because it misrepresents the attitude of others. If the writer is desirous of imparting the beneficial results of his wide experience, it is unfair in him to deprive his communication of the authority which his eminent name would doubtless lend. But it would seem that "Jim Crow" prefers to expose others, whose "little knowledge" he considers a "dangerous thing." There is nothing in the question of safe wiring which justifies this writer's display of wit, not to mention his attacks upon the competence and integrity of those who have not the mental development necessary to make them coincide with his anonymous views.

"The National Electrical Code" is not intended as the only guide for contractors and engineers, and it does not touch upon many of the most important engineering considerations, such as percentage of loss in the line, efficiency of machinery, locations of distribution centers, etc. It requires that all material, devices and systems used, must be up to a certain standard of safety, in order that insurance companies may have something definite to base rates upon. The code has grown up with the electrical business, and, like the business, it contains some real inconsistencies and some apparent contradictions that escaped the committee which codified the rules. On some subjects the requirements should be more specific and comprehensive.

The use of plain iron pipe for conduit is one of the subjects which attracted much discussion both before and since the passage of the 1897 code. The question is not, are two safety factors better than one? but "Is iron pipe a safe conduit for low tension work?"

In my letter of July 22 I had in mind those cases where electrical current is supplied to the consumer from central stations of wires run in the open air, and subject to lightning discharges. This is the case with a very large proportion of the electric lighting and power distribution in this part of the Union. There are also many cases where crosses between high tension arc, or alternating current circuits and low tension lighting circuits occur. Whenever this happens, the insulation on the low tension wiring is almost certain to give way at some point, generally at the place where insulation is the weakest, which is most frequently at the insulating joint of some combination fixture—a very bad place for a fire to start. This statement can be verified by any one who will consult the quarterly report of electrical fires and burnouts. If the conduit is of iron and the breakdown takes place within it, and if the conduit itself is the best ground obtainable, the danger of fire is very much diminished. If, however, the conduit is not electrically continuous, as described in my letter of July 22, the fire hazard is increased by the use of iron conduit, whether lined or unlined pipe be used.

In the letter just referred to is the statement: "The piping must be electrically continuous and heavily grounded, with a ground of carrying capacity equal to that of the largest wire in the system." Your correspondent distorts this (after quoting it correctly) to mean "a ground connection, continuous the entire length of the tube and having current capacity equal to that of the largest conductor of the wiring system." Of course each pipe need not have carrying capacity greater than that of the wire within it, as the wire and consequently the pipe, in case of grounds, is protected by the nearest fuse, as stated in my previous letter. The ground should run directly from the main junction box to earth.

Wherever current is derived from a source perfectly protected against high potentials, it may be that conduits not bonded together give satisfaction, although it is better to bond them. Plain iron pipes not joined together should never be used. Competent engineers should be employed to plan and superintend all electrical work of importance and the public will continue to suffer whenever such service is dispensed with, for the underwriters' inspection covers only a part of the ground.

"Engineers and contractors would do well to look into these matters carefully before placing too much reliance on the misleading statement of those who, unwittingly or otherwise, misrepresent the true condition of affairs and who at least show a lack of familiarity with the character of the goods at present on the market."

Underwriters encourage the use of armored conduits, but do not feel justified in condemning iron pipe; moreover, iron pipe can be made electrically continuous, if proper care is taken to do so.

FREE WIRING SYNDICATES IN ENGLAND.

(FROM OUR LONDON CORRESPONDENT).

THOSE who have followed the course of electric lighting progress in England during the last year may have heard of the predicted increase in the popularity of the electric light due to the adoption of a system of "free wiring," and they have perhaps wondered whether the English central station engineer has been reduced to the extremity of offering to wire the houses of intending consumers free of charge in order to fully load his plant. Although free wiring is merely considered by the central station man as a means of bettering his load curve, it must not be thought that it entails an increased investment or expenditure on his part, beyond perhaps the expenditure of a little more time in his bookkeeping.

The idea of free wiring first originated with a syndicate calling themselves the Electric Free Wiring Syndicate, who proposed to accept payment for the wiring of houses by a certain sum paid by the householder for every kilowatt hour of electrical energy metered to him, this sum being naturally in addition to that paid to the supply company in the usual course. This could only be done with the concurrence of the supply company, but it is easily imagined that this was not difficult to obtain. Not only is it a great thing for the central station man to be able to increase his lamp-connection without even having to canvass for it, but the consumers gained in this way are in most cases of the kind who are the most profitable to him.

It is especially in the less wealthy residential districts that such a scheme finds favor. There are numbers of householders who consider it too extravagant to pay for the wiring of a house already, perhaps, fitted with gas-pipes, or who would consider it foolish to pay for the installation of electric light in a house belonging to their landlord. But these will undertake gladly to pay what seems the ridiculously small sum of a penny (2 cents) per kilowatt hour more for the electrical energy in return for having their wiring done free of charge. And these consumers living in the smaller houses have a much more beneficial effect on the shape of the load curve than shops, large houses and places of business. They will have probably a small but constant number of lamps burning from dusk till bedtime, instead of putting a large load on the network for short periods at a time. Thus this free wiring proves acceptable to the landlord, who gets his house wired for nothing; to the tenant, who pays a high rate for the interest and depreciation of the wiring and fittings without knowing or without minding, while he smiles at not having had to pay the cost of the installaation; to the central station man, who gets a new consumer whose habits tend to improve his load curve; and last, but not least, to the free wiring people, who get a good payment for their investment.

The system was first tried by the Electric Free Wiring Syndicate in the district of Wallasey, in Cheshire, and it proved so successful there that the Syndicate have already arranged terms for similar contracts with six electric lighting concerns in or near London, and the municipal electric light works at Blackpool and Worcester. A company has now been formed with a share capital of £250,000 to take over and extend the business of the Syndicate. This company, which bears the title of the National Electric Free Wiring Company, limited, has five gentlemen, connected as managers or directors with other large electric lighting concerns, as directors, and a rosy future may be safely predicted for it. According to the contracts with the local electric supply authorities, the company will wire the premises of intending consumers free of charge, the supply authority collecting the revenue, including that due to the Free Wiring Company, in the usual way, and a sum not exceeding 1 penny (two cents) per kilowatt hour, will be paid back to the company.

In addition, the agreements with the London companies provide for a minimum payment to the Free Wiring Company of 1 shilling (25 cents) per 8 c. p. lamp, or its equivalent, installed. It should also be mentioned that the agreements with the supply authorities provide an option of purchase on the part of the consumer or the authorities.

The legal aspect of the system has been carefully considered

and advised upon by eminent counsel, and upon their advice the legal ownership of the wires and fittings supplied by the company will be vested in the local supply authority until all payments to the Free Wiring Company have been discharged, but the agreement between the Free Wiring Company and the local authority will provide that such legal ownership is to be subject to the right of the former company to receive such payments.

The company is of course in reality nothing more than a large money-lending concern, which lends money at a high rate of interest against a moderately good security. It must be remembered that a large proportion of the cost of wiring a house is due to labor, and that in no case could more than a part of the capital invested be recovered; it is, therefore, not at all unfair that a high rate of interest be obtained for the investment, as a large sum ought by rights to be written off for depreciation on each house wired, directly the work has been done. At all events the undertaking will probably prove of such service to the electric lighting industry that one cannot but wish it every success.

STANDARDIZING INCANDESCENT LAMPS.

In response to a request for lamps to be used for a standardizing test, addressed by the secretary of the National Electric Light Association to the United Electric Improvement Company, of Philadelphia, the general manager of that company, Mr. Walter F. Smith, has sent the following letter to the secretary of the association:

I regret that we have not found it convenient to submit incandescent lamps of our manufacture (as per your request of August 2) for your standardizing test. While we recognize that such a test would offer considerable information and possibly be desirable to many, yet we are rather inclined to think that the efforts of the National Electric Light Association directed in a movement to standardize the voltages upon the circuits of central stations throughout the country would result in more immediate results to both manufacturer and consumer than the standardizing of incandescent lamps.

The source of great dissatisfaction in the use of incandescent lamps does not lie in the lack of a standard, but principally from the varying voltages upon the circuits of many of the central stations as well as isolated plants. I regret that I have not the time at my disposal to go into this matter more in detail. If I had, I am quite sure I could convince you that standardizing in the directions herein indicated would be more desirable and had I been present at the meeting of your association when the movement was started to carry out the arrangement for standardizing lamps I should have certainly opposed it with all vigor possible, for the reasons herein given.

NEW YORK CITY is now in communication over the long distance telephone lines with St. Joseph, Mo., through Omaha and will soon have an alternative route through St. Louis and Kansas City.

ELECTRIC POWER IN THE AMERICAN ORDNANCE COMPANY'S WORKS, BRIDGEPORT, CONN.

WHEN the American Ordnance Company was formed, two years ago, it determined to erect new works and to equip them with the best machinery and apparatus which the present state of the mechanic arts afforded. Being engaged in the manufacture of ordnance of all kinds for the United States Government, and also special machine work, it was necessarily compelled to adopt this step, with the result that the new factory is claimed to be the best equipped of its kind in the counry.

Animated by the desire to adopt every approved modern appliance, the company, without hesitation, concluded to equip its factory throughout with electric motors for driving the machinery, and the results attained have amply shown the wisdom of this step.

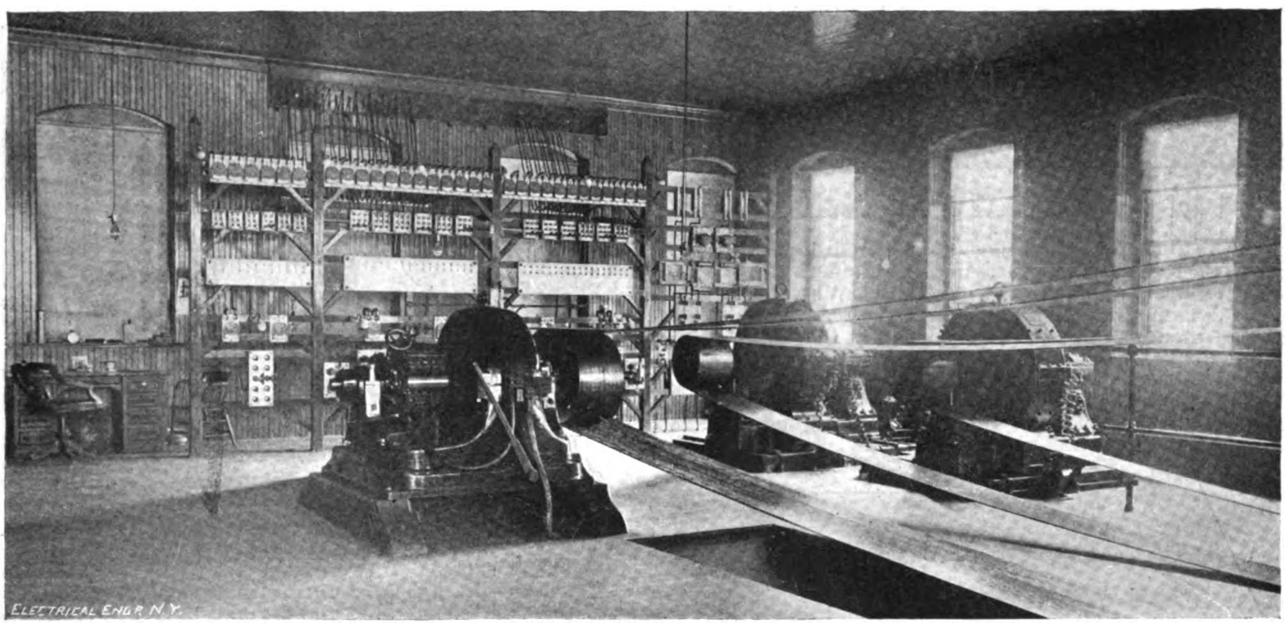
THE BOILERS AND ENGINE.

In the boiler room there are installed two Cunningham boilers of 125 h. p. each and one Roberts boiler of 140 h. p. On the latter 140 pounds of steam is carried, which is used to test the turbines of the Howell torpedo, manufactured by this company. The shop is heated by the Warren Webster heating system, using exhaust steam from the engine.

In the engine and dynamo room there is installed an improved Greene engine, with cylinder 20-inch bore and 42-inch stroke. It is built for a cross compound 500 h. p., but at present the high pressure side only is installed, which gives 250 h. p., enough for the present needs of the company. There is a Springfield electric stop on the engine, operated automatically by the engine itself and also by push buttons arranged at different places throughout the shop. The flywheel of the engine is 20 feet in diameter, with a 44-inch face, weighs 22 tons and makes 95 revolutions per minute. A 40-inch triple ply, perforated belt drives a jackshaft, the latter making 250 revolutions per minute, on which are mounted two 76-inch and two 80-inch Dodge friction clutches, with wood face pulleys, from which are driven by means of belts two 75 k. w. multipolar Westinghouse generators at 750 revolutions per minute and two Thomson welding generators, used for welding shells of large size.

GENERATORS AND SWITCHBOARD.

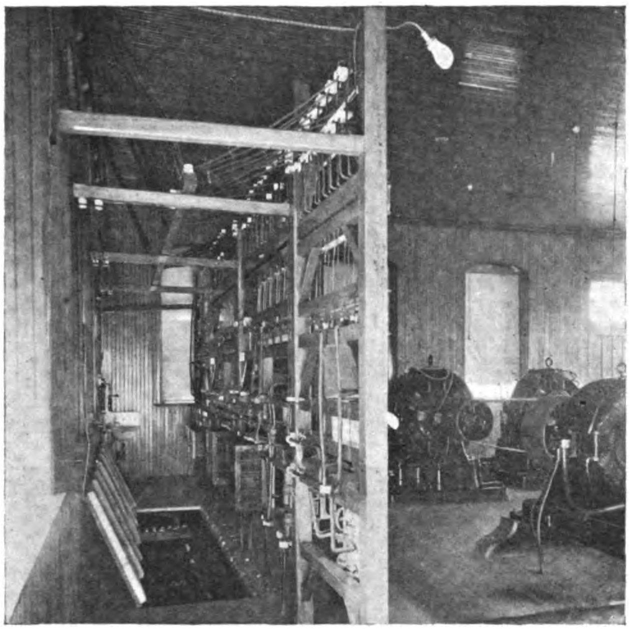
The two 75 k. w. generators are connected upon the three-wire system and furnish power for motors and lights with which the factory is equipped. There are at present installed about 1,500 16 c. p. 125 volt lamps and 38 enclosed long burning arc lamps, and 18 motors, ranging in size from 5 to 15



DYNAMOS AND SWITCHBOARD, AMERICAN ORDNANCE CO., BRIDGEPORT, CONN.

h. p. A general view of the dynamo room is shown in the accompanying engraving, and also a rear view of the switchboard. The sides and ceiling of this room are covered with white spruce, natural finish.

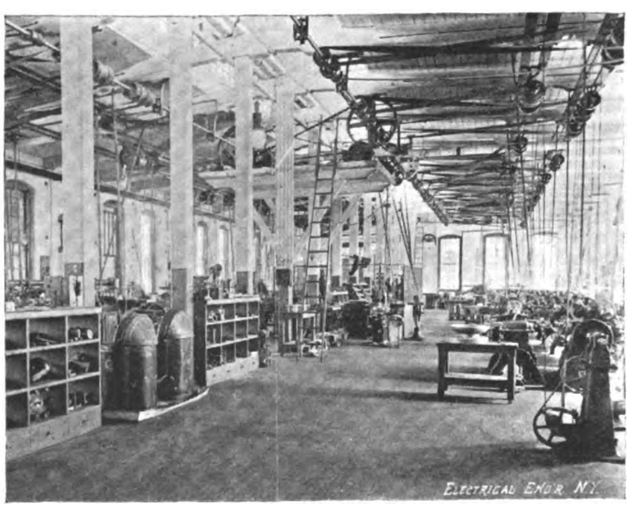
In installing the dynamos there was first laid a foundation of stone 3 feet wide, 20 feet long and 3 feet deep. These foundations were laid every three feet lengthwise of the room, and a 10x11-inch beam on top bolted on to that. On these was laid a 5-inch flooring, composed of spruce, pine and maple. The dy-



View Showing Rear of Switchboard.

namos were then set on the floor and bolted down, thus giving a perfect foundation and leaving room underneath the floor to run wires from dynamo to switchboard. Wires are first led from the dynamo through a brick pit to the rear of the switchboard and then up through glass insulators through the floor to the switchboard itself.

The switchboard, although plain, is exceedingly handsome and fully equipped. It is skeleton framed and made of ash, polished. It is 24 feet long, 10 feet high and stands 4 feet from the wall, giving ample room to get all around it. Wires



View Showing Three Motors Driving Shafting from Platform.

first go through I. T. E. circuit breakers, then through the main switches to the bus bars. From the two outside bars wires lead off to the switch, which controls the panel for the motor circuits. From there they run to a distributing board, from which is taken the six circuits which supply the motors. The six wires lead from the bus bars to two distributing boards, from which lead the lighting circuits. All the wires run from the top of the switchboard through porcelain insulators built into the brick wall, and from there to the junction pole.

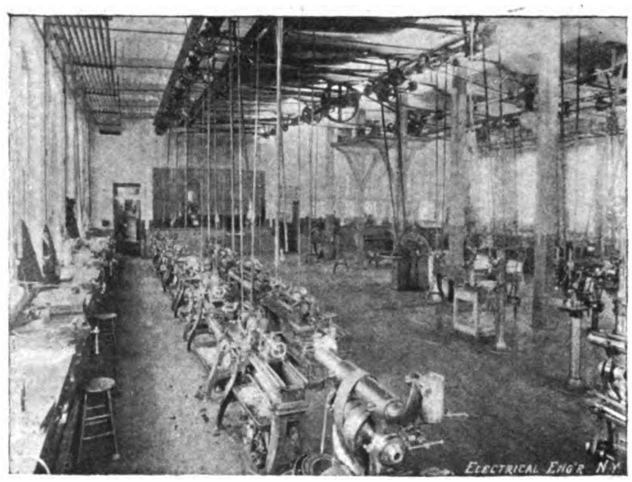
In installing the plant the question came up as to how much loss should be allowed on the line; whether to use copper plentifully and have very little loss, or use little copper and have plenty of loss and a continual expense after the plant was installed. It was decided to use plenty of copper and have as little loss as possible. So the plant was installed for a drop of two volts on the motor circuits and one volt on the lights, which gave a loss of only 1 per cent.

THE MOTORS.

The motors, ranging from 5 to 15 h. p., are set upon platforms built about six feet from the ceiling, so they are entirely out of the way and take up no floor space. Four of the seven 5 h. p. motors drive individual machines. The rest of the motors, which include one 6 h. p., four 7½ h. p., four 10 h. p. and two 15 h. p., drive short lengths of shafting in different buildings, with the exception of the 6 h. p., which is an Otis motor and runs an Otis freight elevator.

These eighteen motors represent five different makes, and have been running over a year. There has never been a burnout on any of them, and it is very hard to choose after a year's run which gives the best satisfaction, as they all run without any sparking or trouble whatever, and some of them have been very badly overloaded. There is an outlet over each motor for compressed air, which is connected up with the compressed air system with which the factory is equipped. The air is carried at eighty-five pounds pressure, and each motor is thoroughly cleaned out with it twice a week.

The factory is also equipped with an intercommunicating



View of Model Room, Driven by 7½ H. P. Motor.

telephone system of twenty-one telephones. They are connected up with a small point board at each instrument, so that anyone can telephone to another and have a private line. The telephones give very good satisfaction and have paid for themselves a number of times over in time saved.

Of course there has been no comparison made in economy between running from motors and belting from the engine, as motors were started in the first place; but the results obtained can only lead to one conclusion, the superiority of the electric method. The entire electrical equipment was installed under the direction of Mr. E. C. Crocker, electrical engineer for the company.

A WOMAN ELECTRICIAN.

A dispatch from Syracuse, N. Y., states that the new Wieting Opera House, which has just been opened there, was wired by a woman. Mrs. W. J. Blackburn, of New York, wife of a theatrical electrician, came there on July 10 to execute for her husband the contract for the electrical work and continued solely in charge of it until a few days before the opening. It was quite a complicated job, there being 1,250 incandescent lights for the auditorium, stage and lobby. Mrs. Blackburn makes a specialty of designing switchboards, and with her husband has wired many prominent theaters, including the new Manhattan in New York, the Montauk and Bijou in Brooklyn, and several in Chicago. Four years ago Mr. and Mrs. Blackburn removed to New York from Chicago, where they held permanent contracts with the Chicago Opera Opera House and the Columbia Theatre. Mrs. Blackburn says the work is fascinating, and as far as she knows she is the only woman in the country who makes this a business.

LITERATURE

ELECTRIC RAILWAYS AND TRAMWAYS. THEIR CONSTRUCTION AND OPERATION. By Philip Dawson, C. E., New York, 1897, John Wiley & Sons. 705 pages, demiquarto. 530 illustrations; 183 tables; half morocco ,gilt top. Price, $12.50.

For nearly two years past our excellent contemporary, London Engineering, has been printing a series of excellent articles on electric traction in all its aspects. These articles have attracted deserved attention on account of the painstaking care with which they were prepared, and by their uniform accuracy. The author has gathered these articles together and they now form the basis of the present book, to which has been added much new and valuable material, bringing the whole well up to date.

The work as it stands may well be considered the magnum opus on electric railway work, and, considering that American work furnishes the text for the largest proportion of its contents, it is all the more noteworthy from the fact that it is from the pen of an Englishman. Perhaps the very fact, however, that the electric railway has become, one might say, an everyday topic to Americans, has made its treatment by a foreigner, less saturated with the subject, an advantage, as he would be more likely to seize upon and bring out details, which to a native American might have appeared obvious and to that extent superfluous.

The author has subdivided his subject into 35 chapters and an appendix, in which he has omitted no detail at all likely to be of value to the engineering reader. In an introductory chapter on the early history and development of electric traction in America are recorded the remarkable growth of our electric traction work, the author not confining himself to mere statistics regarding cars, but also showing the benefits derived in the cost of operation as compared with horse and cable roads. Coming to the engineering side of the subject he describes in succession the permanent way or track, illustrating various types of rails and track construction employed, and following this by similar descriptions of the return circuit, in which he discusses the various methods of bonding employed, including electric welding, with an adequate reference to electrolytic action, etc. A special chapter is devoted to "Elevated Conductor Construction," under which are described a great variety of what we term in America as overhead material, such as trolley wire, section switches and insulators, frogs, crossings, together with the mechanical details for the erection of the trolley wire. Two chapters indeed are devoted especially to the latter subject, in which we find excellent practical details as to the methods of suspension and allowable sag, the types of poles usually employed, tower wagons, and in addition tables showing the cost of labor, material, pole planting, etc. In all this work there is scarcely a detail which has been omitted and when one considers the extent of this detail this is saying a good deal.

The various types of electric motors form the subject of chapter 8, in which are included descriptions of all the various types of American and foreign motors, which have thus far been employed in practice, together with tables showing the average horse power exerted by street car motors, the efficiency curves, and various other details. Under the head of speed regulators we note the description of the series parallel controller, and this chapter also includes tables and general data on traction co-efficients under various conditions of service.

In successive chapters the author takes up car wiring and equipment and motor trucks, in which we notice he describes none but American apparatus. Also car construction, in which is included the methods of car heating, lighting, snow sweepers, etc., concluding this part of the subject with chapters on car wheels, brakes and on the trolley. In the latter he describes the Mather & Platt and Siemens-Halske German form of trolley. We also notice description of the side acting trolley, lately brought out by Mr. R. W. Blackwell and now on trial at Bristol.

The author then leaves the car and track work and discusses the electric railway power house, describing in successive chapters the various types of engines and dynamos which have proved successful in practice and giving much practical information on switchboard construction and instruments, dynamo foundations, the care of generators, the handling of coal, car sheds and repair shops, and a variety of other power house detail. Thus far the descriptions of the author may be said to be confined to individual apparatus, but in the succeeding chapters he describes in excellent detail a number of existing electric railway systems, among them that of the West End Railway in Boston, the Chicago City Railway, the City and Suburban of Baltimore, the Cass Avenue & Fair Grounds Railway of St. Louis and other typical power plants, including finally the long distance power transmissions at Portland and Oregon City.

Under the chapter entitled, "Electric Railway Locomotives" the author deals with the electric railway locomotive as distinguished from the motor car constructed with a view to train haulage and here we find described the locomotives operating the Union Pacific coal mines at Rocky Springs and the B. & O. Baltimore tunnel locomotives, together with other examples of this class of work. Under the head of "Electric Main Line Railways" we also find descriptions of the Nantasket Beach and the Metropolitan Railway of Chicago. Crossing the Atlantic, the author devotes a chapter to a description of nine British electric railways, including those of Dublin and Bristol, the Liverpool overhead and the City & South London Underground, giving very complete details of all these roads. This is followed by a chapter on combined light and power stations, which contains descriptions of the Hamburg and Altona stations in Germany and the Tivoli station in Italy.

All the systems thus far described are operated with overhead conductors, but to complete the record the author devotes a chapter to open conduit systems, in which we find excellent accounts of the principal successful conduit roads now in operation, including those at Budapest, Washington, Lenox Avenue, New York, and elsewhere, together with costs of construction, and other detailed information. In line with this there is also a chapter on surface conduit systems, in which the principal systems of this type in operation and proposed are set forth. The storage battery as applied to traction purposes forms the subject of a short but interesting chapter, giving details of what has been done in this field of electric traction up to date, with the exception of the road in Chicago, which went into operation but a few months ago.

The author rounds up the descriptions above enumerated by a chapter on specifications, in which he includes specifications for every department of electric railway work, including track, power house, cars, etc. This chapter includes copies of actual specifications, which ought to be a valuable guide to engineers employed in such work.

The remaining part of the volume is devoted to what may be called the management and accounting of electric railways and contains a large mass of information of a most valuable character on the maintenance of the equipment, management of lines, organization, discipline, etc., and ending with a chapter on the statistics and working expenses of railways both in England and America. The only criticism we have to make on this part of the work is that the values are given in English pounds, shillings and pence instead of in United States values. Still, the conversion factors are so simple that the value of these tables is perhaps little impaired thereby. Finally an appendix gives the various English Board of Trade regulations with respect to electric tramways and electric railway legal enactments in Great Britain. We also notice a short index of books and periodicals connected with electric traction, which have been consulted by the author, and which may prove of use to others in search of more detailed information on some of the subjects treated of in the body of the work.

Being a record of work actually performed, there is little, if anything, to criticise in the volume before us. On the contrary, we have only words of praise for the energy and industry of the author, who has given us a work far and away the best that has yet appeared on this subject. Indeed, it is a great work on a great art. It is also a matter for congratulation that the volume has been gotten up in every way commensurate with the value of its contents. We congratulate both the author and the publishers on their enterprise in placing before engineers a work of such a high and lasting value.

NEW FIRE ISLAND LIGHTSHIP.

The new steam lightship, No. 68, has been moored in position off Fire Island, in place of the older vessel, 39, which has been on duty there since the new lightship post was established. The new vessel will show simultaneously from three lenses encircling each masthead a fixed white incandescent 100 c. p. electric light, which may be seen in clear weather fifteen feet above the sea thirteen nautical miles. Should the electric light machinery become inoperative, three lens lanterns will be displayed on each mast. During thick or foggy weather a twelve-inch steam whistle will sound blasts of three seconds' duration, separated by silent intervals of four and twenty seconds.

THE

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THE WEAKNESSES OF MUNICIPAL OWNERSHIP.

THE dismal failure of the municipal gas works in Philadelphia, to which attention has again been called recently by the earnest recommendation of Mayor Warwick that the works be leased, is naturally provoking much discussion everywhere. Such facts cannot well be concealed, but the most bigoted municipalists try to make the least of them, or point to some other place where, they assert, things are different. At the present moment the matter is before a Councils' Committee, and we note that in an argument before it Mr. J. C. Bullitt made a number of new and excellent points against city ownership. In the first place, the city is handicapped by the necessity of advertising for bids for its materials, this often leading to a combination among the bidders whereby the city is compelled to pay more than is paid by others. Then, again, Mr. Bullitt says, even with the application of civil service rules the municipal officers cannot relieve themselves entirely of the influence of political considerations. Private corporations, he said, which are stimulated by their interest, can secure greater efficiency and better service in manufacturing enterprises than can be obtained through civil service regulations. Neither can the city be forehanded in preparations for future business. The municipal officer may not be able to command the funds needed to make improvements. It must also be borne in mind that, if the duty is imposed upon the municipal authorities to furnish gas at so low a rate as $1 a thousand, and they cannot furnish gas of a good quality at that rate, then the citizens suffer by having an inferior gas. Finally, results show that the gas rates are not profitable to the city of Philadelphia.

Just at this juncture also Mayor Harrison, of Chicago, in a trip East, steps forward to express his opinion that while municipal ownership may be a good thing, its vast responsibilities in a modern city are more than any mayor can bear, and he favors therefore private lease and operation. He was speaking of street railways, but the argument is just as good applied to lighting. "The management of the business of a street railway is of so exacting and technical a character that it could not be added to the functions of a municipality which a mayor ought to supervise without seriously injuring his usefulness in other directions." That is exactly what the anti-municipalists contend, and yet at this moment lots of good people in New York are actually favoring the expenditure of $50,000,000 on a municipal underground road, many of these people, be it noted, feeling strongly against any government ownership of telegraphs, railways or other properties.

This inconsistency is curiously brought out by the attitude of Mr. John Wanamaker, who last week, in the hearing at Philadelphia, supported Mr. Bullitt's argument and pointed out very forcibly that by a lease an annual deficit would give place to a guaranteed revenue, and a worn-out plant to a good one. Yet Mr. Wanamaker had the postal telegraph craze very badly, and would have carried the scheme through Congress had he been able; just as his successor had the Government print its own postage stamps, until the latest Postmaster General wants the government to go into the savings bank business.

Another curious commentary on the situaation has been the action of Mayor Harrison in trying to "dead head" himself and party over the Pennsylvania Railroad, because the city of Chicago "protects" the company, and in his breathing out dim threats because he did not get what he wanted. The amount of such dead-heading that would be done by officials when all the lighting plants, street railways, telegraphs, railroads, ferries and express companies were public property is easily to be imagined. though it is not easy to imagine how universal bankruptcy could long be deferred.

HOW TO BECOME AN ELECTRICAL ENGINEER.

BARELY a week passes without an inquiry being addressed to us by anxious parents or ambitious youths as to the best way to go about to enter the profession of electrical engineering. That the interest is not confined to this country alone is evident by the recent action of one of our London contemporaries, who instituted a prize contest for the best letter on "How to Become An Electrical Engineer." The communication which, in the estimation of our contemporary, was entitled to the first prize is reprinted on another page of this issue, and will make interesting reading to those who contemplate entering the profession. Of course, the advice contained in the letter we publish is based on conditions such as they exist in England, but there is sufficient general information contained in it to make it of value to American readers. As to the general merits of the scheme outlined by our contemporary's correspondent, there can be no question, but we should hardly go so far as to say that the recommendations contained therein are to be followed without modification under all conditions. Indeed, there is considerable doubt among those best qualified to judge as to several essential points which arise in the carrying out of such a plan. Thus, among other things, the question as to whether it would be better to start out first in shop practice, and end up with a course of study, or vice versa, depends largely on the habits and temperament of the individual. To a lad chafing under the restraints of the class room an interval of shop practice would undoubtedly be a change for the better, whereas a lad naturally inclined to study might find greater benefit in a continuation of mental training before undertaking tne rough work of the shop. Then again, the bodily condition of the aspirant to electrical engineering honors is also to be taken into consideration. A boy of robust health would be able to stand the early rising and late study entailed upon the shop apprentice without detriment, whereas a boy of weaker build would find the same procedure too great a tax upon his constitution, as many have found to their regret. The facilities offered at the present time by many of our colleges and universities for acquiring a knowledge in electrical engineering naturally causes nearly all of those who are able to stand the expense to adopt the practice of taking their practical apprentice course after the course of studies is finished. Whether this always leads to the best results is a debatable question. We know of one

electrical engineer, for example, who stands at the very top of his profession, who will have absolutely nothing to do with "college graduates." Of course this is an extreme case, but we dare say there are others who look with suspicion upon the average youth with a sheepskin. This, of course, does not demonstrate that our present college courses are of no value, but the fact remains that unless the college course is backed up by practical experience, obtained either before or after graduation, it leaves the graduate at a great disadvantage as compared with those who have already gained their practical experience. No one expects that any college course, however comprehensive it may be, can turn out full fledged electrical engineers, and what has been said is intended merely to impress upon would-be electrical engineers the importance above anything, of obtaining that practical knowledge, without which all theoretical and book knowledge is of little avail.

THE TRIALS OF THE STORAGE BATTERY.

THE storage battery has gone through so many trials and tribulations in the past that those interested in its promotion have become callous to the criticisms one still hears now and then. These aspersions usually emanate from those who are not fully informed on the present state of the art and hence carry no weight in themselves, but they are nevertheless apt to influence the judgment of the general public, and to that extent may do harm to an important branch of electrical industry. The most recent example of such loose and unwarranted statements regarding the storage battery is contained in an article recently appearing in the New York "Commercial Advertiser." The article states that Mr. John Jacob Astor and Dr. Seward Webb had decided to abandon the use of the Samuels storage battery in their private yachts and cars and this, according to our contemporary, "marks another significant failure in this favorite method of electrical propulsion." We refrain from rehearsing the painful details of this failure, as recited by the "Commercial Advertiser," but its conclusions are so obviously unjust that it seems worth while to point out one or two facts of which our contemporary may not be aware. It is probably true that the cells mentioned were abandoned, but that proves absolutely nothing, as to the applicability of storage batteries to electrical boat propulsion or train lighting. It only proves that the Samuels battery was unsuited to its purpose. As a matter of fact Mr. Astor, so far from having lost confidence in storage batteries, has replaced the worthless cells by others of tried efficiency. So far as storage batteries on electric launches is concerned the electric fleet at Chicago, in 1893, settled that question once for all and one would have supposed that their wonderful performance there was sufficiently well known to have made our contemporary hesitate before committing itself to so sweeping a statement. Since then the Atlanta Exposition and scores of private electric launches all over the country have only gone to strengthen the hold of this method of marine propulsion on the public. Within the week, indeed, the Czar of Russia, after investigation by his naval experts, has ordered an electric launch from America.

As to the storage battery in railway work, the recent excellent showing made by the battery in Hanover and Dresden and in Paris, and lately in Chicago, are sufficient evidence of its adaptability to railway purposes. And as for stationary work the merest tyro in electrical matters knows their acknowledged value in almost every situation. If our contemporary had only taken the trouble to go a stone's throw from its office it might have seen a most excellent exemplification of what the modern storage battery can do, in the Bowling Green Building. Indeed, it is quite probable that our contemporary's office at certain times is lighted by current obtained from that very battery. The daily press, we are glad to note, as a rule, have learned to treat electrical matters in a quite intelligent manner, but the utterances of our contemporary indicate that there is still need of educational effort in some daily newspaper offices.

FREE WIRING.

THE question whether electric light wiring shall be paid for by the consumer or by the electric lighting company was at one time a very live topic of discussion among the central station companies in the United States, and although we do not hear so much of it at the present time we imagine that not a few companies, especially those in smaller towns, are still on the fence, as it were, concerning this matter. In the larger cities the establishment of wiring contractors has given companies an opportunity to turn over consumers directly to these concerns and thus to relieve themselves of a profitless and usually thankless class of work; but the fact still remains that the paths of electric lighting companies could be made smoother if some way could be found to relieve them as well as the consumers of the cost of wiring. It seems, however, that a very good way out of this difficulty has been found in England by the establishment of what are known as free wiring syndicates. Of course, the name is in a certain sense a misnomer, but the principle upon which these companies operate is such as to apparently give the consumer a complete installation without his paying for it in cash. The idea, as detailed by our London correspondent on another page, consists in furnishing consumers with complete installations and making a fixed charge therefor, which is added to his monthly electric lighting bill, the free wiring syndicate and the electric supply company working in conjunction in this matter. We must say that the scheme commends itself to us as a very practical one, and well worth a trial in this country. In not a few instances that have come to our knowledge the first cost of wiring has acted as a deterrent to would-be customers and the frequently onerous requirements made by municipal and fire underwriters' boards have within the last few years aggravated this evil to no little extent. We have no doubt that free wiring syndicates in our larger cities would meet with a hearty welcome.

ELECTRICITY AND BANK BURGLARY.

A GREAT deal has been made lately of the facility with which the electric current can be used to bore into bank safes, and sensational items on the subject are now actively on their rounds. We have controverted these ideas, and have adduced the weighty evidence and opinion of many well known authorities to the effect that electricity is rather an agency that the burglar will not resort to. We had meantime had a lingering idea that the "story" was an old one and we have at last run it down. As a matter of fact the notion appears to have been ventilated first by a German electrical paper in 1890 or 1891, for we find a letter in June, 1891, to the Boston Commercial-Bulletin on the subject from Mr. G. L. Damon, as president of the Damon Safe and Iron Works, in which all the sensational points are gone over and their ridiculous nature pointed out.

No one denies that electric current will melt metal; from all that follows from that postulate as to the necessity of special protection against electrical safe burglary, is pretty thin air. We are told that burglars are shrewd and keen and never let a new feasible plan get by them. Yet here is proof that the idea has been in newspaper circulation since early in 1891, nearly seven years, while not a single burglary of the kind has been reported in the whole civilized world. Two incipient attempts have been reported, but it is said that they were not the work of genuine burglars. Anyhow, whatever they were, they failed.

WE describe in this issue a system of multiplex telegraphy which marks a decided departure in quadruplex work. We understand results from tests so far made indicate considerable improvement over the standard now in use.

ELECTRIC TRANSPORTATION

ELECTRIC STREET RAILWAY REPAIR SHOPS.[1]

BY R. DUNNING.

THE repairs of the electric road which operates twelve or fifteen cars, are, generally speaking, as varied in character as those of a much larger road, but it would be impossible for the small road to maintain a repair equipment equal to that of the large road, so much of their repair work must of necessity be done outside. But it is of the larger road which I speak, the road which operates from 100 to 400 cars. In the lists of machinery and tools which I have prepared I have aimed to give only those which are most generally useful. As the volume of work increases, many little conveniences for its quick and easy handling will suggest themselves and can be added to the equipment.

The machine shop, with its auxiliaries, the blacksmith shop, truck room and armature room, naturally takes precedence in repair work. The value of a convenient arrangement of these departments and the proper location in each of work benches and machinery to give full working space cannot be overestimated. To find that you cannot operate your speed drill press at times on account of work in the shaper or planer being in the way is aggravating and unprofitable. In a factory where new work is being turned out space may be economized, but in a repair shop you know not what a day may bring in to you. A good rule to observe in this matter is to take as much room as you think you will need and then double it.

A lathe equipment consisting of one 24-inch, one 20-inch and one 10-inch speed lathe will meet all ordinary requirements of that class of work. The larger lathes should be provided with gib crane, fitted with differential or air pressure lifts for the safe handling of heavy work. Two large drill presses, 22-inch and 26-inch, and one speed drill press will do the work of that department.

The other machinery may be listed about as follows: A good milling machine (not necessarily universal); shaper with 18-inch stroke; hydraulic wheel press; pinion press; vertical wheel boring machine; axle lathe; power shearing machine; power hack saw; power thread cutter, right and left; power punch, and the necessary bending and shaping machines for sheet iron and tin work.

The grinding work can be done with one dry and one wet grinder, a fine and coarse emery wheel, and there should also be a set of buffing wheels for finishing car and electric fittings. A babbiting furnace and suitably arranged gas or charcoal stoves are a necessity. The air for blowing these fires may be provided by a tank and pump operated from a special pulley on the overhead shafting.

The necessary vises and hand tools must be according to the men and work, but in the matter of wrenches I prefer the solid jaw fitted to standard nuts to the screw or set wrench. A good arrangement with regard to tools is to have a special tool room in charge of a competent tool maker and a check system for the purpose of making the workmen responsible for tools drawn.

In the armature room, besides the necessary work benches and armature stands, a binding machine, a field winding machine and bake oven are essential. A gib crane or overhead trolley with chain falls are necessary for the proper handling of armatures, and a full outfit for testing work completes this equipment.

The truck shop, besides the usual assembling tools, should have an overhead hand-power crane of from four to five thousand pounds capacity for the safe handling of motors, etc.

The carpenter shop next claims our attention. The same rules which apply to space and arrangement in the machine shop apply here. The following outfit of machinery will do for all ordinary work: Planer; resurfacing machine; jointer; mortiser, boring machine; shaper; wood turning machine; band saw; emery wheel; good grindstone.

A first-class man should be in charge of the machinery, who thoroughly understands the grinding and sharpening of tools, and it should be his work to see that not only the machines are kept in order, but also that tools owned and used by workmen are in proper shape.

In the space devoted to work on car bodies see that there is plenty of room for necessary trestle benches and the convenient handling of work. Pit room for half a dozen cars is a necessity. As a means of moving cars and trucks between carpenter, machine and truck shops, an electric transfer table will be found most convenient.

The paint shop should be constructed so that it will have good roof light, and the width between the tracks should be sufficient to allow the work to be performed on cars standing parallel and not to crowd the workmen; in other words, the gauge lines of tracks should be between 7 and 8 feet and should be of such capacity so as to have the cars pass through regularly every 9 or 10 months. The floor should be of concrete, with a smooth surface, so that it would be easily kept clean and free from dirt, and should also be graded to be easily drained.

The power for operating the machinery can generally be best furnished by motors in each shop conveniently located, and so set up as to permit of quick substitution in case of a burnout or break down.

Many small repairs which can be done by hand, such as the replacing of trolley wheels, switches, bell or register cords, etc., can be as well done in the carhouse proper as in the shops, and result in a considerable saving of time, and I think it well to have tracks set aside for this work and have the conductors of cars instructed to run cars in need of certain repairs on to those tracks when coming into the barn, and to leave a note on file in the barn foreman's office stating repairs needed.

In the whole general scheme of repair work there are minor but yet important parts which go to round out and complete the whole. Among these is the pattern maker, a visit to whose den shows many minute reminders of the transitory state of affairs even in the street railway business, and the draughting room, where a look through the drawers and pigeon holes reveals many ideas "born to blush unseen" by the outside world.

I do not wish to create the impression that repair work is the one great and vital factor in street railroad economy, but I do wish to claim a high place for it. Look well to the repair department.

[1]Abstract of a paper read before the N. Y. State Street Ry. Assoc., at Niagara Falls.

TRACK BONDING—HOW CAN WE OBTAIN THE BEST RESULTS?[1]

BY H. C. NEWTON.

An equipment consisting of a first-class 600 volt voltmeter and a 250 ampere ammeter with a motor car and an accurate knowledge of the voltage carried at the station is all the apparatus and data necessary to determine the quantities involved and to obtain with fair approximation the loss which is going on in the circuit outside of the motors and the generators at the station.

The first factor in the determination, viz.: the loss in the trolley line, is, to some extent, a known quantity. You have already, or can figure easily the resistance of the trolley and the feed, and by assuming a certain volume of current, the amount of energy lost, varying of course with the power consumed, is at once arrived at. The second factor must be obtained by the subtraction of the determined factor from the total loss. For this total loss your instruments come in play, and it is only by a series of readings on them with the car in motion on the road, and the determination thereby of the watts spent in running the motors, that a satisfactory result can be obtained. The difference betweeen the voltage, as shown on the voltmeter, and the volts shown on the voltmeter at the station, multiplied by the current, gives us this result. The difference between this result and the loss obtained for the trolley and trolley feed lines by calculation, should give us the loss in the track of the power employed for that individual car. The result is generally astonishing, especially if the traffic is heavy; and there are cities not a thousand miles from here where the sun of the horse car rail is not yet set, where reading will show 50 and 60 per cent. loss at certain times.

To obtain the best results a rail joint should have an equal, or, better, a greater current carrying capacity than the body of the rail itself. The engineer will possibly remember specifying a four nought copper bond at the time the last piece of nine-inch girder was laid in the congested district, and congratulating himself on thus getting what he thought was a first-class job of bonding. And yet when he comes to consider that that rail has probably nine times the current carrying capacity of the bond itself, and the bond is only riveted or upset in some way in the hole in the rail, and instead of having six times its cross sectional area in contact with the steel of the rail, it has possibly two, he will perceive that there is some reason to doubt whether he has such a first-class job after all.

A water works system which was so laid out that 10 per cent.

[1]Abstract of a paper read before the N. Y. State Street Ry. Assoc., at Niagara Falls.

of the power at the station was spent in overcoming friction in the mains, would not be regarded with much favor. On the same principle, a street railway system on which a similar percentage of the power is lost in the rail should hardly be considered as a perfect example of electric railroad practice. Yet I will venture the assertion that there are not more than a score of roads in the United States to-uay that can prove a more satisfactory condition of affairs. The trolley feeder systems are carefully calculated, but the rail is bonded, how little or how well is immaterial; the ground will take care of what slops over.

With all due deference to the ideas of the track man, whose greatest glory is in a perfect roadbed, and to those of the electrical engineer whose hobby is a complete trolley feeder system with a theoretical loss of 5 per cent., I must yet insist on the importance of the rail return. Down in Syracuse we use the soldered bond with no track feeders on the permanent way. The rail bonding is of No. 0000 capacity and double throughout. The congested district of the city, the common center, is not (as it should be) bonded to equal the capacity of the rail section. Our financial backing has not been educated to that extent as yet, and would regard such an outlay as extravagance. The whole track, however, is in such a condition, where the above-named bond has been used, that a low reading voltmeter has failed at any time to detect a difference of potential between water pipes and rail, and the Western Union Telegraph Company, with its keen nose for electrolytic action, has been unable to locate a drop between their lead covered return and the iron of the rail, the attempt being made with an instrument reading to 1-100th of a volt.

The importance of a true metallic return cannot be overestimated. Where the chance for corrosion between bond and rail is allowed to remain the certainty of an interrupted contact one day is assured. The jar produced at the joint by the impact of the car wheels results in vibration enough to loosen fish-plate bolts, and in the natural course of events must loosen rivets as well.

The rail should be one mass of continuous metal throughout to give permanency of electrical contact. It must, therefore, be homogeneous. To make it so some process of brazing or soldering must be adopted. The former process has been found impracticable except in cases where it is possible to take advantage of welding currents, or return currents of immense volume. These can be obtained ordinarily only at the power station, or by a large expenditure for special welding apparatus. With these considerations in view the conclusion is forced upon us that the really practicable process is to solder the bond to the rail. Experience has proven it economical in first cost, and most desirable in the character of the results obtained.

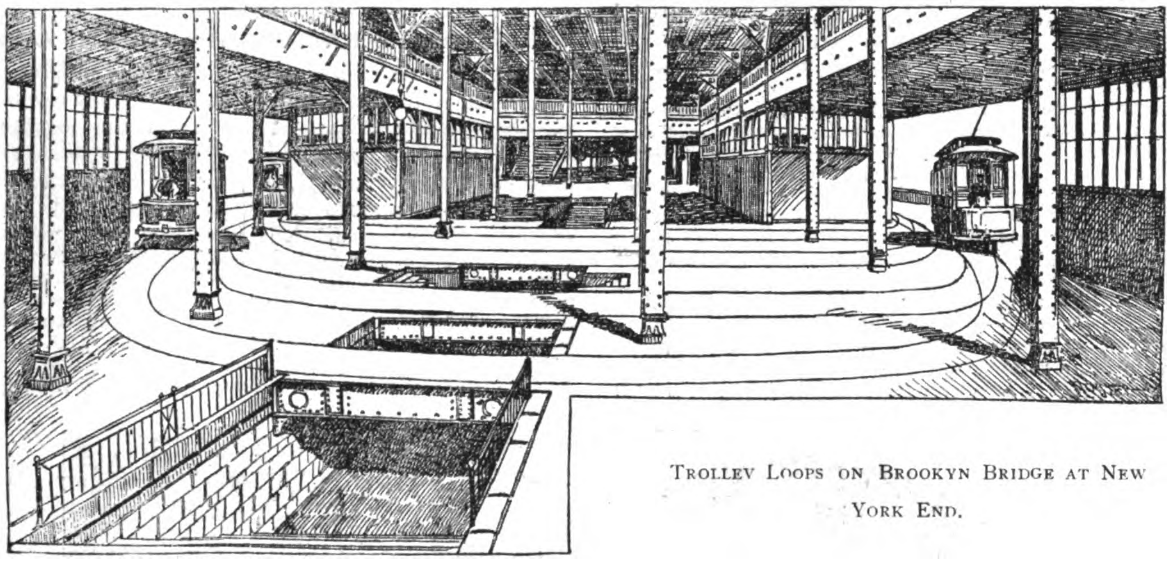
The current carrying capacity or the number and section area of the bond conductors should depend upon the location of the track, many and large for the crowded districts and at the points where the great volume of return current flows before entering the return feeders to the power house, of smaller number and capacity in the outlying districts. With these provisions for perfecting the ground comes as a matter of course freedom from electrolysis and water and gaspipe corrosion, and a saving in overhead negative feed lines, which should be of immense importance in the design of the permanent system.

TROLLEY CARS ON THE BROOKLYN BRIDGE.

AFTER considerable discussion the Brooklyn Bridge trustees have adopted the plans submitted by their engineer for the running of the Brooklyn trolley cars over the Bridge.

The principal feature of the new plans is to bring the trolley cars across the Bridge on street levels at both ends. The twenty-one trolley lines of Brooklyn will run down Washington street to the Bridge, and, keeping close to the inside of the roadway, will cross on a single track to the New York side. Here, by means of a series of switches, the single track will branch into four loops laid across the south side of the present promenade, as shown in the accompanying engraving. The trolley cars will thus form a continuous procession back and forth between the two boroughs.

The first of these four loops will cut off the northwest corner of the men's toilet room and the southwest corner of the ladies' toilet room. The fourth loop will sweep so close to the present stairway leading to the Bridge cars that it will have to be removed and altered. The new plans provide for a new stairway at this point forty feet wide.



TROLLEY LOOPS ON BROOKYN BRIDGE AT NEW YORK END.

The trustees argue that the presence of the trolley cars, enabling persons to ride across the Bridge gratis, will inevitably reduce the present crush. To provide against collisions with those who wish to cross by the promenade it is purposed to construct a subway under the trolley loops which will be about eighty feet long, twelve feet wide and seven or eight feet deep.

A noteworthy feature in connection with this privilege granted to the trolley companies is that it is accompanied by no money consideration, the Bridge trustees holding that the arrangement will in the first place relieve the crush on the Bridge cars, while at the same time permitting trolley passengers to ride across the Bridge free of cost.

STREET CAR WHEELS.—SHOULD THEY BE MADE HEAVIER?[1]

BY F. D. RUSSELL.

MOTOR wheels have been undergoing during the last nine years a somewhat similar development to that of motors, trucks and cars, and may be said to have kept pace with what has been required of them. Our first 30-inch motor wheel weighed 250 pounds or 260 pounds, and our first 33-inch was a 300 pound wheel, and, I may add, this is a good pattern yet, for moderate sized cars at not over 15 or 18 miles. Next we came to 280 pounds for the 30-inch and 325 pounds for the 33-inch, and then, which was about four years ago, to 300 pounds and 350 pounds respectively, and remained at that for a couple of years or so, with the exception, of course, of special lots from time to time. About a year and a half ago we added about twenty pounds to wheels for interurban service, which brought us to 370 pounds, or 380 pounds. We also brought out a 400-pound wheel, having eight spokes or arms instead of the usual number of seven, for fast long runs, also snow plow and snow sweeper and sprinkler service. These are all 33-inch wheels. On 30-inch we now run about 325 pounds,

[1]Read before the N. Y. State Street Ry. Assoc., Niagara Falls.

sometimes to 335 pounds, and 350 pounds, but 325 pounds is probably heavy enough for a 30-inch wheel.

I do not wish to be understood that mere weight is in any sense desirable. The lighter the wheel, in fact, the lighter the whole equipment within limits, the better it is for the roadbed. The service is bad enough for the tracks as it is, without adding any more weight than is absolutetly necessary. A comparison of the weights of the motors will show that the increase has been mainly in capacity. Take, for example, two Westinghouse motors, viz., the 15 h. p. of 1890 and the 50 h. p. of 1896. These both weighed 2,400 pounds. And so it has been with us to an extent. There is a great deal in the manufacture of a wheel besides the mere question of weight. The question of the pattern, the careful proportionment of all parts to obviate strains of cooling, the mixture and the treatment of the iron, as well as the annealing of the wheels, not to mention any number of minor things, which have to be watched carefully, all these must be combined to produce a thoroughly reliable wheel. To sum up briefly, and taking the 33-inch wheel for a standard, our conclusion is that 380 pounds to 400 pounds on 2¼ inch and 2½ inch tread is not any too much for the present service.

There are two factors which try the very withers of cast iron wheels. One is the twist or torsional strain as the motor drives the wheel, and the other is the heating of the periphery of the wheel from the friction generated by high speed, or continued application of the brakes. This latter, I firmly believe, is the hardest part of the service required of a motor wheel, because it tends to expand the rim, and set up a severe strain where the arms, which remain cool, unite with the rim. All our patterns are designed to resist this strain.

Now a few words on the subject of standards—axle standards, I mean, for the wheels, in tread and flange, are gradually approaching as near to a standard as the varying conditions of service will admit. We lately purchased about 1,000 bars of steel for axles, and it was nothing short of a Chinese puzzle to make up a list which would properly cover our needs. Taking the trucks in order of length of axle, we have:

Taylor, axle 6 feet 3 inches long.

Peckham, axle 6 feet 4⅝ inches long and 6 feet 6 ⅝ inches long.

Brill, axle 6 feet 5 inches long.

McGuire, axle 6 feet 5 inches long and 6 feet 6 inches long.

Bemis and Baltimore, axle 6 feet 5¼ inches long.

Diamond, axle 6 feet 5½ inches long.

I have not at hand the lengths of the DuPont or Dorner & Dutton, or any other axles not mentioned in the above list, but you can depend upon it, they are different. The foregoing lengths are on standard gauge and usual tread, which means, not exceeding 2½ inches. All, I believe, are subject to variation where wheels have treads wider than 2¾ inches, and, of course, for wider or narrower than standard gauge.

My idea in speaking of these varying lengths of axles is to suggest whether you cannot get together and establish a standard axle, and by amicable arrangement with the various truck makers, bring about the adoption of a standard length of axle, a standard journal, a standard brass and a standard box. The Master Car Builders of the steam railroads long ago took exactly such action, and it is nothing new which I suggest. They have a uniform standard. Their axle is 6 feet 11¼ inches long, and the journals and boxes and brasses are interchangeable the country over. If they could establish such a standard, why cannot street railways arrange for the same? Instead of interfering with the interests of any truck maker, it seems to me it would benefit and it certainly would simplify matters enormously for everybody concerned.

STORAGE BATTERY TRACTION IN PARIS.[1]

ELECTRIC traction is not making rapid progress in Paris. While in foreign countries and in country towns we daily see new installations of electric tramways established and very rapidly developed, we remain in Paris with a few lines provided with accumulator cars and with a single line having contacts with the surface of the earth. The question of aerial or subterranean conductors is, in fact, of high importance, and does not seem as yet upon the point of being solved.

Meanwhile we shall make known the new arrangements adopted by the Society of Tramways, of Paris, and the Department of the Seine for the lines that run from the Madeleine to Courbevoie, to Courbevoie-Neuilly and to Levallois, and that have the respective lengths of 4, 4¼ and 3¼ miles.

The system adopted is electric propulsion by rapidly charged accumulators. The charging is effected in a few minutes and during the period of stoppage at the termini of the road. The installation that we are about to describe was made by the Societe Industrielle de Monteurs Electriques et a Vapeur.

The generating works are established at Quai National, at Puteaux. They contain three Babcock & Wilcox multitubular boilers capable of furnishing 3,960 pounds of steam per hour at a pressure of 245 pounds to the square inch. These boilers supply three Willans triple expansion steam engines, each directly actuating a four pole Brown dynamo of 200 amperes and 600 volts at 460 revolutions a minute. The steam engines are capable of running with exhaust in open air or condensing.

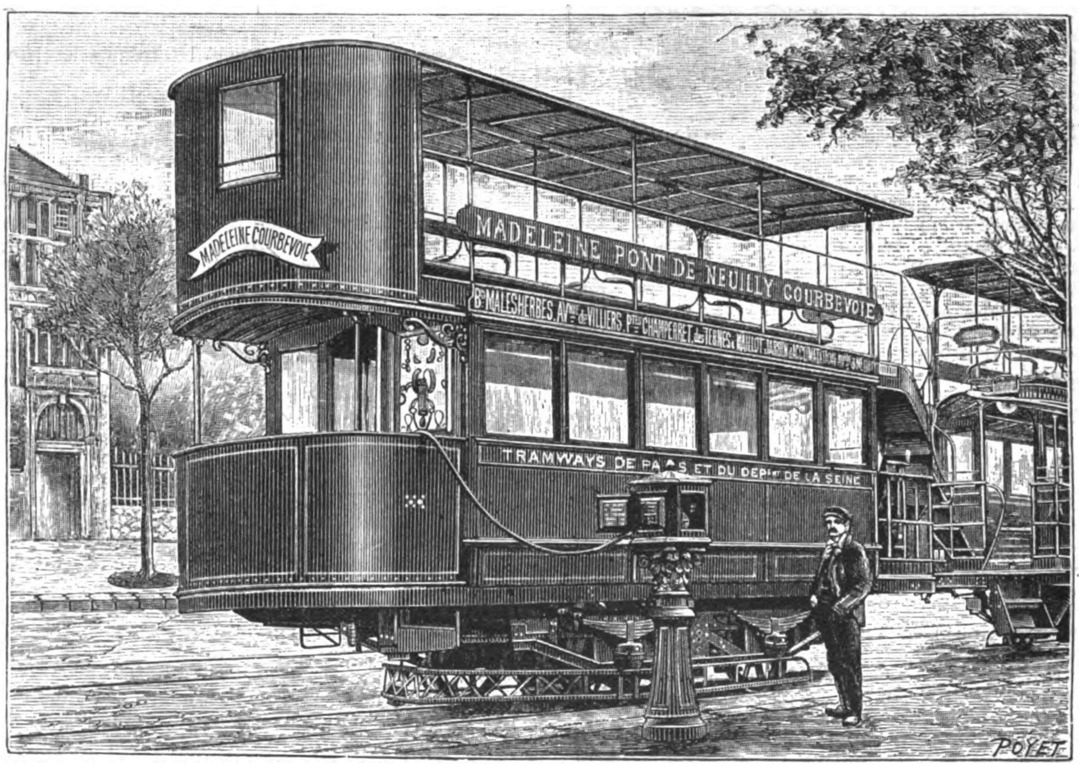


FIG. 1.—VIEW OF PARIS STORAGE BATTERY CAR IN PROCESS OF BEING CHARGED.

[1] La Nature

The water necessary for the condensation and the supply of the boilers is taken from the Seine by a pump actuated by an electric motor.

Each dynamo is connected with a special panel by a circuit that traverses two circuit breakers and a bipolar interrupter. From the distributing bars start six feeders, one of which is designed for supplying the charge to the depot, two for actuating the electric pumps and for lighting and the three others for charging the cars at a distance.

Of the three feeders, one, of a section of 0.25 square inch, does duty for the charging station at Courbevoie-Neuilly; the second, of 0.25 square inch section, is connected with Courbevoie (Place Victor Hugo), and the third ends at Levallois, upon the edge of the Seine. They are formed of lead-covered cables placed directly in the ground.

At each charging station there is installed a post of a form similar to that of a fire alarm box. The feeders are connected with a small internal board, and a plug switch permits of putting the post in connection with the car (Fig. 1).

The cars have a seating capacity for fifty-two passengers and are double-decked. Each weighs in running order fourteen tons and is capable of hauling a trailer of seven tons. It contains 200 Tudor accumulators, each with five forty-two pound plates placed under the seats in hermetically closed boxes. Fig. 2 gives a view of the space beneath the seats in which the accumulators are placed.

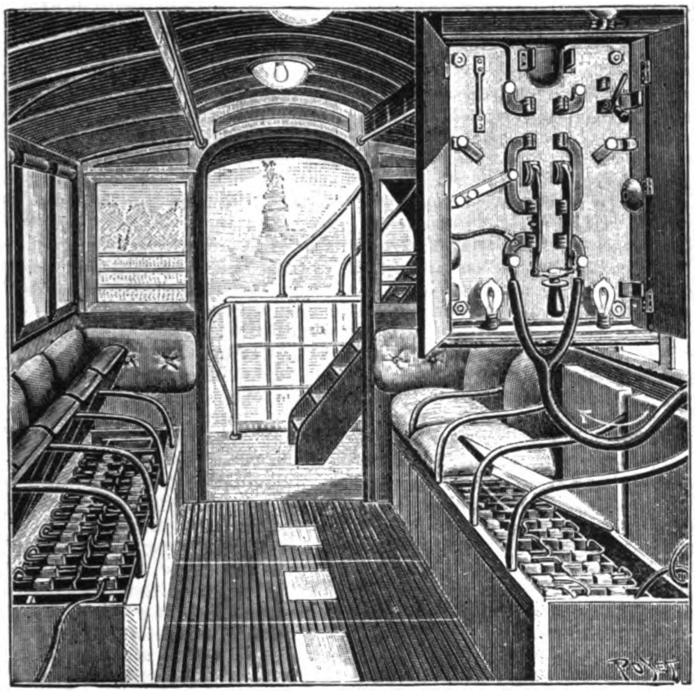


FIG. 2.—INTERIOR VIEW OF A CAR, SHOWING DISTRIBUTING BOARD AND ARRANGEMENT OF THE ACCUMULATORS.

The charging is done at a constant difference of potential. The battery, all the elements of which are mounted in tension, is put in communication with the charging station through a small board that may be seen in front in Fig. 2. The mean intensity of the charge is 120 amperes and the duration from 10 to 12 minutes.

Each car is provided with two motors of 25 h. p., each revolving 500 times a minute and actuating each of the two axles through a steel pinion and a cast iron wheel. The running speed allowed by the regulations is 9½ miles an hour outside of Paris and 7½ miles within. The car is provided with a controller that also permits of cutting out a battery, if an accident should happen. Upon a normal run all the accumulators are coupled in tension. In addition to the rope brake worked by the handle of the controller, each car is provided with screw brakes and sand-boxes. The car is lighted with six electric lamps in series with the battery. Two small electric fans serve for driving to the exterior the gases generated during the charging.

These few data, although very incomplete, show us that it is a question in Paris of an interesting experiment that will give an idea of the practical value of propulsion by means of Tudor accumulators. Some interesting results have already been obtained at Hanover.

THE INFLUENCE OF ACCURATE MEASUREMENTS UPON ECONOMIC OPERATION.[1]

BY C. D. HASKINS.

MANY generating stations in the early days followed a system of readings of ammeters and voltmeters, basing their assumptions as to the actual output on the product of coincident readings multiplied of course by the time factor; thus obtaining an approximataion of the kilowatt hours output per day and therefore the approximate cost of generation per k. w. hour. Many, however, abandoned these frequent readings of instruments, feeling that the approximations of true output measurement were too unreliable to be of real value, because of the constant fluctuation of load between readings.

The conditions just described are in reality those of yesterday rather than to-day, and they existed only up to that time when it became possible to obtain output meters of sufficient capacity to measure in an accurate and proper manner the true output. Such meters as those to which I refer are now readily obtainable and are being rapidly adopted not only by street railway companies, but by lighting companies also.

Electrical engineering skill has responded to the needs of the industries to which it is tributary and standard designs now exist up to capacities as high as 8,000 amperes. Whilst special instruments have been designed large enough for 16,000 amperes.

These total output meters are accurate to a high degree, not only upon steady and normal loads, but upon rapidly fluctuating loads as well, giving a true account of all energy output through them on loads ranging from 5 to 6 per cent. of their rated capacity up to about 15 per cent. above their rated capacity. The reliability of the record is unaffected by the rapidity of fluctuation of current between these points.

It is doubtless needless for me to emphasize the real economic value of the reliable data which can be obtained by the use of these total output meters. Knowing the efficiency which is to be expected from the generator, engine and boiler equipments, it is a simple matter to determine just how much coal and water should have been expended for the run of any given day to generate the indicated k. w. hours output. Thus it not only becomes possible to determine just what it is costing to generate a k. w. hour, but it also becomes possible to check the inefficiency of the equipment and to locate trivial faults which might otherwise have escaped notice.

For example, should the indicated output fall 10 per cent. below what ought reasonably to be expected from the known input of coal and water, an effort would at once be made to determine where the trouble lay; whether in uneven firing of the boilers, ill-set valves on the engine or some minor fault in the generator. In no other way known to me can this positive means of check upon a generating system be maintained than by the use of total output meters.

Important as is the measurement of the total station output there is yet another application of positive measurements which, whilst it has been long appreciated by many, has not been applied in practice at all up to the present time, simply because the necessary meter was not available. I refer to the measurement of the energy used daily to operate each car.

Every street railway management realizes that quite a large proportion of the total energy generated is wasted by the careless and improper use of the controller and the brake, and where the old rheostat method of control is used the opportunity for waste on the part of the motorman is yet greater. An average drawn from the opinions which have been expressed to me would indicate that not less than 20 per cent. of the total energy generated is wasted by improper manipulation of the handles upon the part of the motorman; this improper manipulation being due to some extent to ignorance, but more generally to carelessness.

A meter has now been designed which will, I believe, change all of these wasteful conditions. This meter is intended for permanent installation upon the car and its indications show accurately the consumption of energy in k. w. hours for any desired time.

Grave difficulties surrounded the designing of a satisfactory meter for this purpose and the perfecting of the device has only been accomplished by sustained effort extending over a long period. With a street car meter permanently installed on every car the street railway management at once has the same means of checking the motorman, as is provided by the cash register for checking the conductor.

Assuming that the energy wasted is 20 per cent. of the total, as I believe it to be, it is, I think, fair to expect a saving of at least half the present waste, or 10 per cent. of the whole amount of energy generated as a result of the knowledge on the part of the motorman that the management has absolute

[1]Read before the New York State Street Ry. Assoc., Niagara Falls.

means of ascertaining how much power he uses per run, or per passenger, or per mile. For, under this system, he cannot fail to realize that the management has in its possession adequate and reliable data upon which to base promotions or encouragement, reprimand or discharge. Many steam railroads have long made a practice of offering annual prizes to the engine crew doing the most work with the least coal and water, and I anticipate that a similar system of reward may be found advantageous and profitable in street railway practice.

Cutting down the waste of energy nearly 50 per cent. means saving 10 per cent. of the total output and it therefore means to the street railway management either the saving of 10 per cent. of the coal and water which is being used to-day, or the ability to operate 10 per cent. more cars with the same central station capacity. In whichever way the matter may be viewed—whether in the light of a saving of raw material, or an increase in service without increase in expense at the station—the economy accomplished is very great, and you will all, I am sure, agree with me when I venture to assert that the influence of accurate measurement upon economic operation is of the first importance, provided proper use is made of the data thus obtained.

LORD KELVIN AT THE GENERAL ELECTRIC CO.'S WORKS, SCHENECTADY.

LAST Friday, September 24, the opportunity was seized by Lord Kelvin, while staying with Mr. Spencer Trask at Saratoga, to gratify his wish to visit the huge General Electric factory at Schenectady, which is within easy distance of the famous springs. Accordingly a large party gathered by invitation at the works to meet the company's distinguished guest and Lady Kelvin, there being present Messrs. Spencer and Alanson Trask, Dr. Louis Duncan, Dr. Cary T. Hutchinson, Prof. Elihu Thomson, Mr. F. J. Sprague, Vice-President W. F. Merrill, of the Erie Railroad, Mr. R. R. Bowker, G. F. Peabody, Comte di Brazza-Savorgnan and the following officers of the company: Captain Eugene Griffin, J. P. Ord and E. W. Rice, Jr., respectively first, second and third vice-presidents; S. Dana Greene, W. J. Clark, S. M. Hamill, Jr., W. B. Potter, J. R. Lovejoy, J. Conover, J. McGhie, F. Shepard, A. L. Rohrer, J. Kruesi and others. The press was represented by Col. H. G. Prout, E. J. Swann, C. W. Price, C. T. Childs and T. C. Martin. Mr. H. R. Bacon of the Canal & Claiborne Railroad, New Orleans, was also in the party.

The inspection began about 11 a. m. on the arrival of the Saratoga party, and a carriage was provided to take Lord Kelvin around, no unnecessary precaution in view of the enormous amount of ground to be covered. But Lord Kelvin was so active and interested he disdained or forgot his conveyance half the time. The Electrical Engineer has so fully described the great factory and its contents from time to time that most of the details of the trip are familiar to its readers, and note will only be made of one or two new and interesting features and of the new departments.

The testing room, whose methods have been described, was one of the places most attractive to Lord Kelvin. Every machine, before being shipped, is subjected to a most rigid test in order to make sure that it contains no defect of any sort, and is perfect in every respect. A complete record of the test of each machine is kept, so that at any time the performance of any machine can be determined by reference to these test records. The building in which this testing is done is 400 feet long and 100 feet wide, equipped with every sort of appliance for handling the machinery with the utmost rapidity and precision. Ranged on both sides of the centre aisle were machines of all sorts and sizes, from the little one, capable of supplying some fifteen or twenty 16 c. p. lights, to those generators which supply 30,000 lamps. One of these has just been shipped to Brooklyn and the parts of this machine alone made five complete carloads. There were also some large machines for railway work; seven of these, of 1,500 h. p. each, being built for the Metropolitan Traction Company, of New York, for use in connection with the electrical equipment of Fourth and Sixth avenues. Three of 2,000 h. p. each for Boston were also there. In addition to these are some large machines for the transmission of power; two of 1,000 h. p. each for the Western part of Canada and five of 800 h. p. each for the Falls of St. Anthony. Some large transformers were there of 1,250 h. p. each, wound for a potential of 20,000 volts. These are for use at Niagara Falls and Buffalo. There was also one of the 1,200 h. p. smooth core lighting machines, of which two are being built for the Edison Illuminating Company, of New York, with the commutator formed by the armature conductors themselves. These are the largest machines of the sort ever built and are together capable of supplying 30,000 16 c. p. lamps. New direct connected lighting sets were also shown. These sets, consisting of engine and dynamo, mounted on a common base, are remarkable for compactness and solidity. They are especially intended for marine work and small isolated plants and are built in all sizes up to 65 h. p.

There were five 700 h. p. rotary converters, also for St. Anthony Falls.

Connected to this building, and forming part of it, is at one end the main machine shop, where the largest parts are prepared, and on the other end the shipping department, where the machines are boxed and loaded on the cars. The total length of these buildings, all under one roof, is 1,320 feet. Electric cranes run from end to end of this building, carrying the half finished parts from one place to another, until they are finally assembled, tested and loaded on the cars. All this work Lord Kelvin inspected with the utmost care.

Another new building was that for the special handling of sheet iron, where all the sheet iron used in the works is punched, annealed and lacquered. The manipulation of this iron is of great importance in electrical manufacture. To get good and uniform results with electrical apparatus the iron must be purchased with reference to its magnetic qualities and carefully sorted and tested. It must be punched with sharp dies of very accurate dimensions, otherwise it will not build up accurately and will have to be filed after assembling. The necessity of filing surfaces often gives rise to losses which are very serious. The reason for these losses is that the laminations make good electrical contacts on the filed faces and wasteful eddy currents result. After the iron is punched it is annealed with great care at an accurately adjusted temperature. After the punchings are annealed they are evenly lacquered, the lacquer serving to insulate each sheet from its neighbor. The methods of handling sheet iron employed by the General Electric Company are of special interest, and are far in advance of anything of the kind outside of these works. Most of the punchings are made by dies that make the complete piece in a single blow. Many of these dies cost from 500 to 700 dollars and must be kept sharp and in perfect condition. The substitution of quick processes for slow and of machinery for hand work is quite noteworthy.

Lord Kelvin was quite interested to find that there are now being manufactured in the Schenectady works many machines, which until recently have not been used in this country, of the revolving field alternator type. Heretofore the general practice in America has been to use a stationary field structure and to revolve the armature. In the machines in question this practice is reversed. The reason for using the stationary armature is that it can be more readily insulated for very high voltages. The coils being stationary and not subject to any mechanical strain they can be protected and insulated by methods which would be impossible in a revolving structure. Another advantage is that the alternating current does not have to pass through any collector rings or other moving contacts, the only moving contact in the machine being the small collector rings which are used for delivering low tension direct current to the revolving field structure. This field structure is of extremely simple and strong construction. The coils instead of being made of wire are made of ribbon copper wound on edge, each coil being composed of a single spiral of this ribbon.

In the long distance transmission work which is now of very great importance, it is highly desirable that dynamos be wound for the same voltage which is used on the transmission lines, since the use of step-up transformers can thus be avoided. The methods of construction and insulation now used by the General Electric Company, enable them to build dynamos to deliver current at pressures as high as 12,000 and 15,000 volts. Machines were on view in the shops whose insulation was being tested at 25,000 volts. An example of these was the 1,000 k. w. three-phase alternator, built for the Brooklyn Edison Company, which was tested at a pressure of 25,000 volts in the presence of Lord Kelvin and other visitors. The largest machine of revolving field type which has been produced was shipped from the works on Sept. 25 to the Edison Electric Illuminating Company of Brooklyn. This machine is of 2,000 k. w. capacity. Its diameter across the lower armature frame casting is twenty-five feet; its total weight is 163,000 pounds; it is to operate at a speed of 75 revolutions per minute. This machine when shipped from the works was packed on five flat cars. It is by far the largest dynamo ever built there, or perhaps anywhere, although its kilowatt capacity is less than some others. The reason for its great size in proportion to its capacity is that it operates at so low a speed, being directly coupled to a shaft of the engine.

While in the testing department Lord Kelvin was shown by Mr. C. P. Steinmetz an arc of from 180,000 to 250,000 volts, alternating across a 15-inch gap, with brass points. At the first test the points broke down, but the second resulted in a splendid arc, which before it snapped away twisted and coiled till it could not have been less than 30 inches in

length. Tests were also shown of breaking with new fuses and Thomson magnetic blowout currents of 750 h. p. and upward, with no more fuss than is made by an ordinary arc lamp when a hard bit of carbon sticks in its crop. Tests were also made of the G. E. 57 heavy railway motors.

It was, indeed, the railway work that apparently most occupied Lord Kelvin's attention, possibly for the reason that so much of it was in progress and because this is the country that is doing the great bulk of it. He made several references to the subject during the day and while claiming for England the possession of needed skill and productive ability was quick to admit the enormous strides made here. All the newest things, too, were trotted out specially for his inspection, the first being the Potter contact surface system, devised by Mr. W. B. Potter. By its use the slot of the underground conduit system and the overhead wires of the trolley system are superseded by a series of small metal discs set in the pavement of the streets between the rails of the track, each disc projecting above the surface by about one inch. These discs in the experimental track in the General Electric yard are set in parallel rows alternately at a distance of about five feet, one disc near to one rail being the positive or communicating disc, the other the negative or discharging disc. The only live discs are those directly beneath the car. The discs are made of cast iron, the top of the disc, the wearable portion, being readily changed when worn out. Each communicating disc is connected to the main circuit from the dynamo through an automatic magnetic switch. Instead of placing these switches along the track in single boxes they are grouped 20 to 25 in manholes beside the track at distances of about 250 feet. By this means the inspector can descend into the manhole at any time and note the operation of his switches by merely glancing around. The car has two plow bars hung beneath suspended so they will give slightly under pressure. The ends of each bar are curved in order that they may slide over the disc without the risk of catching in it and tearing it before it is placed. The car has a few small cells of storage battery. The length of each of the bars beneath the car is equal to a little more than the distance between two of the discs, which in practice can be widely spaced.

The conductors from the dynamo or the feeders come to the manholes where they are connected to automatic magnetic switches. When the car is at a standstill one of the contact bars is run on one or two of the discs. The wires to the storage batteries are thrown into the circuit and energize a coil in the automatic switch and establishes connection between the motors and the circuit from the dynamo. The moment this is done the battery is cut out, as it has completed its work. The current then comes from the communicating disc and passes through the motors down through to the discharging discs and the rails back to the dynamo. As the car moves along the magnets in the automatic switches are energized in turn and communicate current to the motors, while those discs over which the car has passed become dead the moment the contact bar refuses their service.

The greatest drawback to a street surface contact system has been the fact that when the streets are muddy or wet there is a serious leakage of current from the positive discs to the return circuits. In dry weather this leakage is negligible, but something must be provided to prevent it in wet weather. To avoid this the negative disc in this system is placed in a cast iron box which acts as a shield and which takes any leakage of current which might flow to the positive disc and conducts it to where it ought to go.

Any sparking which might occur in the automatic switches in the manholes are extinguished by Prof. Elihu Thomson's magnetic blowout. It is understood that the General Electric Company have a contract for putting this system down in Monte Carlo.

The electric brake for electric cars, which was shown Lord Kelvin, has been the subject of considerable attention on the part of the Railway Engineers of the General Electric Company. The brake consists of two steel discs, one of which contains a coil of wire, the other is a plain metal disc. The moment the car is stopped and no current is flowing from the controller, the motors then become very powerful dynamos which turn their current into the coil of that one of the discs which is attached to the motor. It then becomes a very powerful electro-magnet with a strong power or attraction. The other disc is revolving on its axle, but the moment the first disc becomes an electro-magnet its attraction is so powerful to the surface of the latter that it is brought to a standstill and with it the car. Should the wheels skid, as on an incline, the armatures of the motors naturally stop; the discs separate, the wheels begin to revolve again and the moment they do so current is generated in the motors and the disc with the coil becomes an electro-magnet and the car stops again. In other words, the brake is always in operation once it is applied. The whole appliance is part of the electrical equipment and so long as the motorman has strength to turn his controller handle the brake must be applied and the car come to a stop. Lord Kelvin on leaving the works rode into Schenectady in a car with this brake, and various stops were made while he leaned eagerly over the open trap-door in the floor of the car to watch the operation.

Before the works were left the inevitable group photograph was taken. Lord Kelvin entered laughingly into the idea and suggested that everybody ought to remove their hats. As it was raining briskly, there was a loud protest, which amused him greatly. After leaving the trolley car on which he studied the magnetic brake Lord Kelvin and his wife drove to the residence of Mr. and Mrs. S. Dana Greene, to lunch. The express train on the New York Central was specially stopped at Schenectady at 2:35 p. m. in order that Lord and Lady Kelvin might accompany Prof. Elihu Thomson to Boston from Albany.

ACCELERATION TESTS AT SCHENECTADY.

AMONG the many events connected with the visit of Lord Kelvin to the works of the General Electric Company at Schenectady, N. Y., none possessed more interest to the electrical railway engineer than the acceleration test made upon the experimental track which runs along the heel path of the Erie Canal for a distance of nearly two miles.

The car used was one of the familiar American elevated railway type provided with four 50 h. p. 500 volt 90 ampere motors, known as C. K. 57's, mounted two on each of the trucks. On each armature shaft was a 33 toothed pinion meshing into a 52 toothed gear fixed to its respective axle. The total weight of the loaded car was twenty-five tons, including trucks, motors and passengers.

At present, owing to the long distance which must be covered by elevated railways and the frequent stops and starts resulting from the nearness of stations, the question of quick starting and stopping has become a serious matter. Quick stopping is, however, well taken care of by both air and electric brakes, leaving rapid acceleration as the point needing attention. Realizing this, the General Electric Company has been experimenting for the past several months with the idea of determing at what rate of acceleration the passengers would be annoyed.

As a starting requirement, Mr. W. B. Potter, chief engineer of the Railway Department, assumed that an acceleration of three miles per hour per second would not be unpleasant and the car was equipped to prove or disprove the assumption. The only departure from ordinary practice was to reduce the gear ratio and use a controller which would admit sufficient current to give the required starting torque. In some of the previous runs the car had attained a speed of 23 miles per hour at the end of 10 seconds, while on the test under consideration the car was moving at the rate of 30 miles per hour at the end of 10 seconds. On this particular run, 5 seconds after the controller handle was moved, the car had attained a speed of 19 miles per hour; at the end of 10 seconds, 30 miles per hour, 15 seconds, 35 miles; 20 seconds, 38 miles, and in 25 seconds, or 5 seconds less than a half minute, a speed of 40.5 miles had been attained.

These figures convey no real idea of the rapidity of the start. However, a comparison with acceleration on steam roads may serve to bring out this point. An ordinary train seldom exceeds a speed of 10 miles per hour at the end of 10 seconds; just one-third the speed attained in the same time by the test car. In a similar test of a regular Manhattan elevated train, at the end of 20 seconds the speed was only 13.5 miles per hour, during which time 198 feet had been covered, as against 38 miles and 356 feet in the case of the electric car.

The sensation due to these rapid starts was not unpleasant and as the starting was perfectly smooth those standing were inconvenienced no more than is now the case with the elevated trains drawn by slower steam locomotives.

OLD B. & O. EMPLOYEES.

The Baltimore Sun is authority for the statement that probably the oldest station agent in the country in point of service is James A. Gary, the Postmaster General of the United States. He was appointed agent at Alberton, Howard county, Maryland, on the Baltimore & Ohio Railroad, some forty-four years ago, and his name still appears on the payrolls of the company. The two next oldest Baltimore & Ohio agents are said to be Captain Charles W. Harvey, at Ellicott City, Md., and John W. Howser, at Relay. They have each been in the service thirty-four years. The Baltimore & Ohio has also, in actual service, a passenger conductor, Captain Harry Green, who has run trains between Baltimore and Cumberland for forty-seven years.

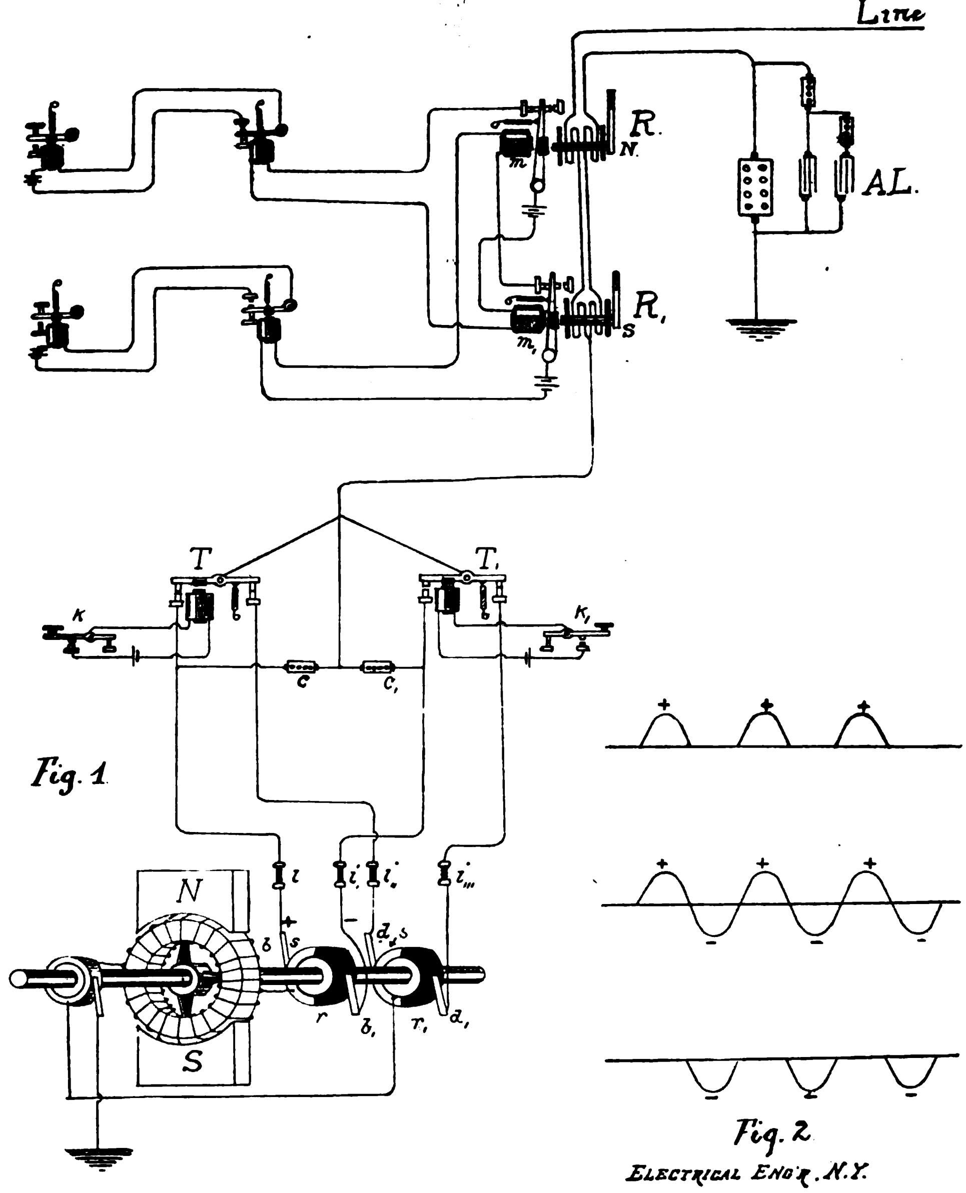
TELEPHONY AND TELEGRAPHY

THE ROBERSON QUADRUPLEX TELEGRAPH.

THE present standard quadruplex, which is operated by reversing the polarity of the current to transmit one message, and by increasing and decreasing the strength of the current on the line for the transmission of the second message has not been the success that was hoped, especially during stormy weather, because of leakage. At such times the increase and decrease is so slight that it often fails to successfully and satisfactorily when the standard quadruplex would only duplex.

Referring to the accompanying diagram, Fig. 2, positive pulses are generated in the dynamo, when section s, Fig. 1, of ring r is passing brush b and are conducted to the front point of transmitter T and, if closed to the line, operate the polarized relay at the distant office that is responsive to positive pulses. The negative pulses are generated when section s_1 of the same ring passes brush b_1, and are conducted to the front point of transmitter T_1 and if closed to the line, operate the polarized relay which is responsive to negative pulses at the distant office.

Ring r_1 on the dynamo shaft completes the circuit to the earth whether one or both transmitters are open and on the back stop, so as not to affect the line balance at the distant office when the transmitters are operated. The small magnets m and m_1 on the relays R and R_1 are for the purpose of maintaining perfect adjustment of the relays, whether one



FIGS. 1 AND 2.—THE ROBERSON QUADRUPLEX TELEGRAPH SYSTEM.

operate the second, or increase and decrease side, and the quadruplex becomes a duplex for the time being.

It was with the view of removing this uncertain operation of the "second" side of the quadruplex that Mr. Oliver R. Roberson, of the Western Union Telegraph Company's electrical engineer office, New York, devised the system described below, in which both sides are operated in the same manner, polarized relays being employed in both.

The system has been devised and put into practical operation between New York and Washington, D. C., 230 miles, for several weeks with very satisfactory and promising results during severe rainy and foggy, as well as in clear, weather. It has never failed to quad when tried on wires where the standard could be operated and on some occasions has worked or both pulses are being received from the distant end of the line. Coils c and c_1 are high resistances shunting the front contact of each transmitter keeping a weak current constantly on the line, and preventing sparking at the transmitter points.

Section s of ring r, which is connected to the armature of the dynamo, and section s_1 of ring r_1, which is connected to the earth, are each 190 degrees of arc, sufficient to allow brushes b_1 and d_1 to make metallic connection with these sections before brushes b and d break connection therefrom, thereby maintaining the circuit intact regardless of the variation or rate of speed of the armatures of dynamos at the two ends of the line. The remaining portion of the rings r and r_1 are insulated, as shown, for the purpose of thoroughly insulating the brushes one from the other except at the time

of no potential. When key K is closed, positive pulses are sent to the line when key K_1 is closed, negative pulses are sent to the line, and when both keys are closed, a complete alternating current is transmitted with a frequency of about 40 periods per second. Polarized relays of the Hughes form with polarized magnet cores have been found the most satisfactory for this system.

The resistance coils l and l_1 are equal to 2 ohms per volt placed in the leads to the transmitters to protect the armature of the dynamo from injury should the transmitters become shortcircuited; coils l_{11} and l_{111} are equal to 2 ohms per volt plus the resistance of the dynamo armature.

We may add that arrangements are now being made to test this system on the longest Western Union circuits the previous results obtained arguing well for its success on the longer lines.

THE MARCONI WIRELESS TELEGRAPH FOR LIGHTSHIPS.

It is stated that a large quantity of instruments have arrived at Dover, England, for use in connection with some experiments in telegraphing without wires. The arrangements include experiments from Fort Burgoyne to the north of Dover Castle and other parts of the surrounding country, which offers facilities for work of this character. From the results which have been attained elsewhere it is believed the system can be successfully applied to lightships. From the position at Dover the Goodwin lightships will be made the objects of experiments under the direction of Mr. W. H. Preece. The sending apparatus will be at Fort Burgoyne, and the receiving apparatus will be moved to different parts of the district.

LETTERS TO THE EDITOR

COMPOUND WIRE FOR LONG DISTANCE TRANSMISSION.

I have recently been considering the details of a long distance three-phase transmission plant which requires several thousand horse power to be transmitted under 20,000 volts pressure. Some twenty miles of the line will pass through a very rugged and crooked canyon where in some cases very long spans are desirable. In such cases conductivity might be sacrificed if greater tensile strength could be gained.

For this work the use of a compound wire, consisting of a steel core with a copper coating, is being considered. Remembering an old experiment with high potential static electricity (which showed that a pipe can be discharged by making contact with the exterior, but not with the interior) it occurred to me that as far as retardation or resistance is concerned, the compound wire might be as good as one of solid copper. Where high potential alternating currents were employed subsequent investigations lead me to the opinion that this is probably true. If it should be verified the information would be of importance to electrical engineers. I would suggest that some of the students of alternate current phenomena make a practical comparison and give your readers the benefit of their investigations. J. C. HENRY.

Denver, Col.

MR. WINCHESTER'S REPLY TO MR. FRANCISCO.

I have carefully read Mr. M. J. Francisco's communication in The Electrical Engineer of Sept. 16 and in reply will simply say that his statements are false, and that I have ample proof at hand to sustain this assertion. I will further add that as the gentleman referred to has seen fit to descend to offensive personalities and to prevarications in lieu of facts, I must respectfully decline to continue the discussion of which he was the instigator.

It will always be my pleasure, as it has in the past, to return courtesy for courtesy to those who desire such information as I am able to give.

ALBERT E. WINCHESTER,
South Norwalk, Conn. Elect. L't. Commissioner.

LIGHTING CLOCK TOWERS.

Have any of your readers had experience in lighting clock towers? I have one to light; it is about sixteen feet square and has four 8-foot dials to illuminate. How can it be done satisfactorily and cheaply? Y.

OBITUARY

W. W. GRISCOM.

The electrical fraternity will be shocked to learn of the death of Mr. W. W. Griscom, of Philadelphia, on Septetmber 27 by the accidental discharge of his gun while hunting in Canada.

Mr. Griscom was well known as president of the Electro Dynamic Company, of Philadelphia. He was a son of John D. Griscom, M.D., and brother of Clement A. Griscom, president of the International Navigation Company. He was born in Philadelphia in 1851 and studied at Haverford College for two years, afterward finishing his course of studies at the University of Pennsylvania, from which institution he graduated in 1870. Besides being the president of the Electro Dynamic Company he was a director of several other well known institutions.

Mr. Griscom was one of the pioneers in electric motor work and his motors occupied a prominent position in the early days of the art.

CHARLES A. WHITE.

We regret to announce the death on September 16 of Mr. Charles A. White, of the Bibber White Company, Boston. Mr. White was a well known figure in Boston electrical circles and his death caused genuine sorrow among a large number of friends and acquaintances. His associates of the Bibber White Company paid a fitting tribute to the memory of the deceased in a set of resolutions which were forwarded to the bereaved family. Mr. White was also president of the Eco Magneto Clock Company, his association with this company dating back many years. Mr. White leaves a widow and son to mourn his loss.

MARY STIERINGER.

It is our sad duty to record the death of Mary Stieringer, wife of Mr. Luther Stieringer, on Saturday, September 25, from heart failure. Her wishes to have her remains incinerated in private were carried out explicitly at the crematory at Fresh Pond, L. I., on Monday, September 27.

NEWS AND NOTES

BROOKLYN'S NEW ELECTRIC COMPANY.

It is rumored that the Kings County Electric Light and Power Company, which has secured a franchise to operate in Brooklyn, N. Y., has purchased the inventions of Nikola Tesla and proposes to use them in its distribution. It is said that a large power house will be constructed, which will be used not only for generating lighting current, but also for furnishing electric power to the Brooklyn elevated roads. Among those interested are Charles Cooper, William Berri, J. P. Morgan, Ex-Governor Flower, D. O. Mills and Vice-President Hobart.

The company has purchased the block fronting on the East River and John street, from Bridge to Gold streets, Brooklyn, at a cost of $500,000. This is about the only large piece of water front property not controlled by the Warehouse Trust, and it is here the first plant of the company is to be erected. Fifty miles of subway have been laid, and by the time the plant is ready it is expected to have one hundred miles of wire ready for operation.

So far as the use of the Tesla system is concerned, both Mr. Tesla and the Westinghouse Company deny any knowledge of the matter.

PINTSCH GAS AND THE DENVER AND RIO GRANDE RAILROAD ACCIDENT.

In our last issue we published an item in reference to the accident on the Denver & Rio Grande Railroad at New Castle, Col., in which it was stated on the authority of a correspondent that "Pintsch gas was responsible for many of the deaths." Further inquiry would make it appear that this statement is not in accordance with the facts, and that although a newspaper report was circulated at the time of the accident to the effect that a Pintsch gas tank had exploded under one of the cars and set fire to the wreck, subsequent

investigation has proved beyond a doubt that not one of the gas tanks exploded, and the railroad officials exonerate the gas apparatus from any blame for the fire.

"The gas tanks from the burned cars were carefully examined by Mr. Henry Schlacks, superintendent of machinery, Denver & Rio Grande Railroad, and Mr. C. H. Quereau, general foreman, Burlington & Missouri River Railroad, and we quote from their report to the Denver & Rio Grande Railroad as follows: "All these tanks had the appearance of going through the fire, and were more or less bent, dented and burnt, and on account of the excessive heat the solder in the joints was melted out and they were more or less warped, but on none of these tanks, no mater how hot they seem to have been, or whatever strain they were subjected to on account of parts falling on them, there is not the slightest indication of an explosion, and we can state without hesitation that these tanks were not exploded at the wreck or anywhere else, and from all appearances they were in first-class condition before the accident. They are the tanks furnished by the Pintsch Company, and the mechanism of these tanks is first-class."

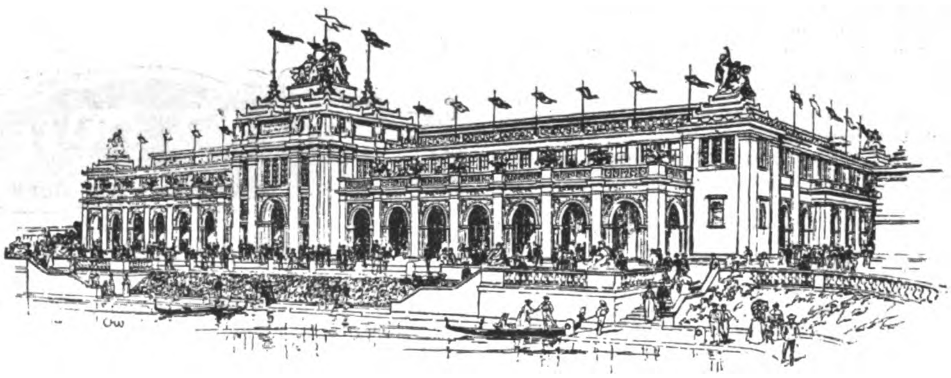
We are very glad to be able to correct our former statement in regard to the action of the Pintsch gas.

MISCELLANEOUS

ELECTRICITY AT THE TRANS-MISSISSIPPI AND INTERNATIONAL EXPOSITION.

WORK on this Exposition, which is to be held at Omaha, Neb, from June 1 to Oct. 1, 1898, is progressing rapidly. Special attention will be given to machinery and particularly to electricity, a separate building being devoted to these features of the Exposition.

The Machinery and Electricity Building, a view of which is given in the accompanying engraving, is located in the northeast corner of the Grand Court, being east of the Mines Building and across the Lagoon from the Manufactures Building. The design is governed by the general conditions requiring harmony with the other buildings; the architecture of the group is modern renaissance.



MACHINERY AND ELECTRICITY BUILDING, TRANS-MISSISSIPPI EXPOSITION.

The building is 304 feet front by 144 feet in depth. There are triple entrances on the main floor level in the center of the main front, and similar groups in the centers of the east and west fronts, with four emergency exits in the north wall. In front of the building, flanking both sides of the main entrance, is an open portico sixteen feet wide, running the entire front of the building. The center entrance feature projects beyond the portico, thus forming the grand entrance vestibule. The main floor covers the entire area of the building. Above is a gallery thirty-two feet in width, extending around the four outer walls. The gallery is reached by spacious staircases located in the front corners of the building. In the rear corners are commodious toilet rooms. This leaves a high central court 248 feet long by 80 feet wide, lighted from the skylights and clere-story windows above the roof.

The character of the exhibits sheltered in this building is shown by the decoration. The ornamental spandrels and panels receive all of their motifs and suggestions from machinery. The cresting at the top is composed of cog wheels, this principle being carried out in all of the decorations. The underlying principle and function of machinery is symbolized by the groups of statuary on the top of the building. At each of the four corners are groups representing the early supremacy of man over the untamed forces of nature. A higher supremacy is shown by the center group, which is the dominating feature of the entire design. In this man devoloped beyond the youthful stage, having wisdom, takes these same untamed, unharnessed forces of nature and harnesses them to his chariot, making them do his bidding, symbolizing in a direct way the service which machinery does for man in using the power of steam, fire, electricity and gravity. Color enters into the design with maximum importance. The entire building will be a series of yellow and ivory tones, growing more intense as they reach the top, culminating in the dull golden statuary full of primitive vigor which surmounts the building and symbolizes its use.

Among the "Midway" attractions at this Exposition will be "Sherman's Umbrella," a massive structure by which passengers are elevated to a height of 300 feet and revolved slowly within a circle whose diameter is 250 feet. At night the tower will be brilliantly illuminated by electricity, while at the apex a powerful search light will be placed. This stream of light may be seen for a distance of 50 miles. The ground space occupied by the umbrella will be 300 feet square. The vertical standard will be 350 feet high, made of steel and iron, and anchored to a stone foundation 30 feet deep and 75 feet square. It will be 40 feet in diameter, or 126 feet in circumference. On the sides of the standard, running from the bottom up, will be forty rails, forming ten tracks for the lower platform to move up and down. On this platform will be a circular track on which another platform is to revolve, the latter platform holding the standard which supports the arms of the umbrella. These arms are to be 110 feet in length, at the extremities of which cars are suspended. From the outer ends of the arms cables will extend to the top of the standard, there connected with counter weights which travel up and down on the inside of the standard. The cars will be constructed on the same principle as those of the Ferris wheel, built of iron and steel, and each will hold forty passengers. There will be sixteen of these cars. The lower platform also will be used for passengers, having a carrying capacity of about 200. This platform will rise to the height of 240 feet.

HOW TO BECOME AN ELECTRICAL ENGINEER.

IN response to a prize offered for the best letter on the above subject, the London Electrical Engineer received a large number of letters. For the information of such as may desire to enter upon an electrical career we print below the letter, which, in the judgment of our contemporary, deserved and received the first prize. The letter reads as follows:

One great principle that is necessary to success in any trade or profession is that any person entering such should do so of his own free will. Far too many young men go into, or are sent into, the engineering trade when they would make better ministers or soldiers, but as engineers they remain failures, because the whole soul is not in the work. The young engineer must be strong and in fit condition to do hard work. He must be willing to get up regularly at 5 or 5:30 each morning, and above all he must be ready at all times to obey his superiors.

If a boy shows a desire to become an engineer he should be kept at school till he is 16 or 17 years of age. The last few years should be spent at an ordinary commercial college, where he will get a good general educataion, which is absolutely necessary to success. On leaving college he should have a good knowledge of geometry, algebra, trigonometry, freehand drawing, physics, inorganic chemistry, magnetism and electricity, practical plane and solid geometry. He should at least have gone through the elementary stages of these. He may now be got into a general engineering shop, where from twenty to thirty hands are employed. Never start in a large shop. In

a small shop a lad of the better class will generally find his fellow-workmen of a lower grade than himself, but he will soon get hardened to that. He may get many odd jobs to start with, such as tending the boiler and engine, or hammerman to the blacksmith, but at such things he will learn a lot. After a few weeks he will get accustomed to his surroundings, and will have started on fitting and erecting. In small shops fitters learn to use all the machines—such as milling, planing, drilling, slotting, shaping, etc. One great advantage that a small shop has is that apprentices learn to make their own tools, and do all sorts of blacksmith work; small shops usually do a great deal of outside repairing work, where a great knowledge can be gained amongst all classes of machinery. This will be found of very great advantage afterward. After about three years on the fitting he will get on to the turning. In small shops from five to eight turners (usually apprentices) are employed, so he will have all classes of work to do, such as screw cutting, shaft turning, boring wheels, pinions, bearing blocks, turning crankshafts, and a lot of other jobs too numerous to mention, both light and heavy. Parents will say that the foregoing is not electrical engineering, but the electrical engineer first requires to be a thorough mechanical engineer. Four or five years might be spent in such a shop as the above, the pay ranging from 3s. 6d. to 16s., all depending on the shop, district and experience of the apprentice. During the foregoing apprenticeship the following classes should be attended: Mathematics, machine drawing and design, steam, applied mechanics, inorganic chemistry, mechanical engineering, statics and dynamics, physics. He should also learn to use the slide rule, which is now in constant use in all offices where calculations have to be done.

The young engineer should now have little difficulty in getting into an electrical works, where he should remain for one or two years. His training would now depend on the circumstances of the parents, but it is not advisable to pay a premium, as it is apt to induce laziness and insubordination in the apprentice. Before starting in an electric shop the apprentice should consider which branch he is to take up, for it is necessary to make a specialty of one branch and stick to it. Different brances are the manufacture of dynamos, motors, and electric power plant generally; also high-speed engines. Another branch is the manufacture of electrical fittings. A specialty is also made of wiring and lighting buildings and vessels. After a year or two in an electric shop the young engineer should get into an office where a specialty is made of the line he wishes to take up. It is rather difficult to get into an office, and if the parents can pay a remuneration it will make matters easier. Several electrical firms in this country do not take premiums, and the best men in their shops usually get into their offices. These firms also pay at least a living wage on starting in their offices. In the office a start will have to be made on tracings and easy pieces of design, and as the man progresses he will get dynamos and motors to design; also high-speed engines, switchboards and resistances, all depending on the firm he has started with. He should also learn to estimate and draw up specifications, both for light and power installations. The great object aimed at nowadays is to produce the best results with the least cost, and this has usually to be done in a specified time.

In conclusion, I cannot do better than quote from Southam's "Electrical Engineering as a Profession and How to Enter It." The management of works, organizataion of factory and men, negotiations, the part taken by the Board of Trade, the local board and municipal authorities in helping or restricting engineering work, the outlooks in various branches of industry in various countries, the cultivation not only of knowledge but sharpness and the sense of responsibility, all these are learnt, not at college, but by apprenticeship with a firm. This is also the view held by all the leading electrical engineers of to-day.

SOCIETY & CLUB NOTES

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 118th meeting of the Institute was held at 12 West 31st street, New York City, on Wednesday, September 29. The report of President Crocker as delegate to the National Conference on Standard Electrical Rules had been made to the council. This report on "The National Electrical Code" was referred to the executive committee of council to the institute for discussion and such action as might seem desirable. At this meeting an opportunity was afforded for discussing the general bearing of this code upon electrical engineering.

INTERNATIONAL ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS.

The second annual convention of the International Association of Fire and Police Telegraph Superintendents closed on September 17 with a banquet at the Maxwell House. The following officers were elected for the ensuing year: Superintendent Ellett, of Elmira, president; Superintendent Brophy, of Boston, vice-president; Superintendent Bosch, of Newark. N. J., treasurer; H. F. Blackwell, of the Brooklyn fire department, secretary; Superintendent F. C. Mason, of Brooklyn, chairman of the Executive Committee. The convention in 1898 will be held in Elmira, N. Y., on September 15.

WEST SIDE NEW YORK Y. M. C. A.

This is the season of the year when ambitious young men are planning to use their leisure evenings for self-culture. The advantages offered by the West Side Branch of the Young Men's Christian Association, 318 West 57th street, should have a strong attraction for all who wish opportunities for improvement.

The building was erected last year at a cost of over $550,000. The equipment throughout is exceptionally fine. The gymnasium has a floor surface of 52 by 109 feet, with skylight overhead. There is an elevated running track, a swimming pool, bowling alleys and lockers with forced ventilation. The instruction in gymnastics given both afternoons and evenings in graded classes will begin October 1.

On Monday evening, October 4, the whole building will be open for inspection to the public and the opening exercises of the evening educational classes will be held in the large auditorium. The subjects taught are especially intended to help young men to advancement in business, arithmetic, penmanship, bookkeeping, commercial law, stenography, typewriting, English grammar and composition, mechanical, architectural and industrial drawing, electrical engineering. Subjects for general culture are elocution, vocal music, orchestral music, first aid to the injured. On Tuesday and Friday nights lectures, concerts or social receptions will be given in the auditorium or parlors.

The fee for membership is only $5 per year, with small additional charges for educational classes and gymnasium. Full information concerning the work may be had of the secretary, Dr. D. E. Yarnell.

PERSONAL

LORD KELVIN last week spent several days in visiting the electrical sights of New York. On Wednesday he was the guest at luncheon of the officers of the New York Edison Illuminating Company, and inspected the Duane street station as well as the Bowling Green Battery station of that company. Later in the day he visited the East 29th street station of the United Electric Light and Power Company. A trip was also made about town and across the Brooklyn Bridge in an electric cab. Thursday was spent at Saratoga and on Friday Lord Kelvin visited the General Electric Works at Schenectady and witnessed some electric railway tests and the operation of the new Potter surface contact railway system.

Lord Kelvin proposes to take a trip to Nova Scotia before returning home.

MR. LUTHER STIERINGER has been looking over the plans submitted to his critical judgment for the Pan-American fair at Grand Island, Niagara, next year, and is most favorably impressed with the possibilities.

MR. M. E. McCASKIE, who was until a few weeks ago superintendent of the McKeesport and Reynoldton branch of the Pittsburg United Traction lines, but recently placed in charge of the Allegheny City branch, was given a surprise at his residence in McKeesport, when H. C. Best, on behalf of the conductors and motormen of the McKeesport line, presented him with a handsome Elk emblem. The superintendent gave the men a banquet.

ACCIDENT AT THE BROOKLYN EDISON STATION.

On Tuesday, September 22, the piston head of a 1,200 h. p. direct connected engine gave way in the Pearl street Edison station in Brooklyn. The cause is being investigated, but it is asserted to be due neither to carelessness nor defective material. The accident caused an interruption of only fifteen minutes in the service, and even this would have been avoided had the new storage battery, completed since the accident, been in working order.

INVENTORS' RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPTEMBER 21, 1897.

Alarms and Signals:—

ELECTRIC ALARM. J. C. Kenmouth, Spearfish, So. Dakota, 590,267. Filed January 20, 1896.
Employs a spring switch released by a trigger when actuated by a snare wire.

SIGNAL MECHANISM. J. P. Coleman, Swissvale, Pa., 590,299. Filed March 27, 1897.
Employs an electric motor to shift the signal in either direction without reversing the motor or gearing.

SIGNALING APPARATUS. J. P. Coleman, Swissvale, Pa., 590,300. Filed April 24, 1897.
Comprises a semaphore signal arranged to go to "danger" when a train is on the block and mechanism to return it to safety position when block is clear.

SIGNALING APPARATUS. J. P. Coleman, Swissvale, Pa., 590,301. Filed May 3, 1897.
Similar to above.

SIGNALING APPARATUS. J. P. Coleman, Swissvale, Pa., 590,302. Filed May 29, 1897.
Similar to above.

SIGNALING APPARATUS. J. P. Coleman, Swissvale, Pa., 590,303. Filed May 20, 1897.
Comprises a crank rotated by a weight connected to a signal, mechanism for controlling its rotation, an electro-magnet controlling the mechanism, a motor for raising the weight and controlled by the magnet.

Conductors, Conduits and Insulators:—

INTERIOR CONDUIT FOR BUILDINGS. H. G. Osburn, Chicago, Ill., 590,373. Filed November 1, 1895.
Comprises a box formed of ceramic material, metallic clips mounted thereon, and a fuse block carrying plates adapted to engage the metallic clips, binding screws being provided in connection with the plates to which the fuse-wire is adapted to be secured.

INTERIOR CONDUIT FOR ELECTRICAL CONDUCTORS. H. G. Osburn, Chicago, Ill., 590,374. Filed March 23, 1896.
Consists of stoneware insulating tubes formed in short lengths from clay containing large percentages of silica and alumina and strongly compressed when given tubular form.

Dynamos and Motors:—

COMMUTATOR AND MEANS FOR ASSEMBLING SAME. S. H. Short, Cleveland, Ohio, 590,466. Filed July 12, 1897.
Comprises a commutator cylinder mounted on a hub, and an expansible ring interposed between the commutator cylinder and the hub.

Electro-Metallurgy:—

ART OF AND APPARATUS FOR AMALGAMATING. W. A. Thacher, New York, 590,504. Filed March 3, 1897.
Consists in mixing with water the material to be treated, passing the mingled water and material in a continuous stream over a series of electrodes, while subjected to the action of electric currents.

PROCESS OF PRODUCING METALLIC CARBIDS. A. H. Cowles, Cleveland, O., 590,514. Filed August 19, 1895.
Consists in causing a current to pass between electrodes laterally projecting into a mass of intimately commingled calcium oxid and carbon, so as to produce between the electrodes a body of the carbid surrounded by an undecomposed mass of the mixture.

APPARATUS FOR EXTRACTING PRECIOUS METALS FROM BLACK SAND, ETC. C. A. Hitchcock, San Francisco, Cal., 590,524. Filed March 3, 1897.
Comprises an inclined table, having longitudinal side bars, an amalgamated electrode forming a plate resting on the table between the side bars, and provided on its upper face with a series of riffle bars, and an upper electrode resting on the side bars, forming a cover.

PROCESS OF PRODUCING HYDRATES OR OTHER SALTS OF ALKALINE METALS. C. Kellner, Hallein, Austria-Hungary. 590,548. Filed November 12, 1892.
Decomposes the metallic salt electrolytically in the presence of a mercury cathode, to produce an amalgam and effects the union of the alkaline metal with oxygen to produce hydrates.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. W. R. Ridings, G. F. Bull and L. B. Cood, Birmingham, Eng., 590,238. Filed May 28, 1896.
Consists of pad which is brought to bear upon the rods carrying the carbon holders by a set of toggle-levers.

Measurements:—

ELECTRIC MEASURING APPARATUS. J. C. Henry, Denver, Col., 590,263. Filed July 3, 1897.
Employs two coils connected, respectively, to the circuits of two motors driving a single vehicle, and a magnetic indicating instrument acted on by both of the coils.

COIN-OPERATED ELECTRICAL APPARATUS. W. B. Wheeler, Lincoln, Neb. 590,427. Filed March 16, 1897.
Details of construction.

Miscellaneous:—

ELECTRICAL IGNITING DEVICE FOR LAMPS. S. M. Meyer, Brooklyn, N. Y., 590,497. Filed April 27, 1895.
Employs a high resistance electrical conductor located adjacent to the upper end of the wick-tube and attached to and supported by the air-distributor.

Railways and Appliances:—

ELECTRIC RAILWAY. R. M. Hunter, Philadelphia, Pa., 590,310. Filed October 27, 1896.
Embodies a horizontally movable collector arm hinged to a frame upon the axles, a collector wheel journaled upon the free end of the arm, and a working conductor upon which the collector wheel runs.

ELECTRIC RAILWAY. R. Lundell, Brooklyn, N. Y., 590,420. Filed July 18, 1896.
Comprises a hermetically sealed switch box, which wholly incloses a switching mechanism, in combination with an outer surrounding bell-shaped portion adapted to act after the manner of a diving bell.

TROLLEY FOR ELECTRIC RAILWAYS. W. E. Kenway, Birmingham, Eng., 590,527. Filed May 4, 1897.
Employs but one conductor placed at curb, whether on single or double track railway.

ELECTRIC RAILWAY. J. A. Roche & J. C. Bley, Chicago, Ill., 590,552. Filed April 13, 1895.
Sectional conduit system contact devices.

Switches, Cut-Outs, Etc.:—

ELECTRIC TRIP KNIFE SWITCH. A. C. Carey, Lake Pleasant, Mass., 590,386. Filed May 24, 1895.
Details of construction.

Telegraphs:—

ELECTRIC SIGNALING. S. De Jager, Paterson, N. J., 590,398. Filed January 23, 1897.
Means for sending a predetermined number of impulses of one polarity followed by an impulse of the opposite polarity, a selecting device comprising two or more groups of magnets, contacts controlled thereby and a receiving device controlled by the contacts.

Telephones:—

COMMON BATTERY MULTIPLE SWITCHBOARD. H. M. Crane, Boston, Mass., 590,304. Filed August 9, 1897.
Details of construction.

THE STOCK MARKET

A SLIGHT REACTION.

The stock market showed a slight reaction on last week's quotations. This was to be expected as a consequence of the heavy buying of the last few weeks, but is not taken as an indication of weakness. Indeed, a slight recovery has already made itself felt and the values of a week ago will be regained and no doubt exceeded with the constantly improving condition of trade.

General Electric is quoted at 37⅞. American Bell, 266 asked. Erie Telephone, 72 asked.

Lake copper is quoted at 11⅞c. on carload lots, and Western copper at 11⅝c. Pig lead, 4.30c.

TRADE NOTES & NOVELTIES

ACTIVITY OF THE CARD ELECTRIC COMPANY.

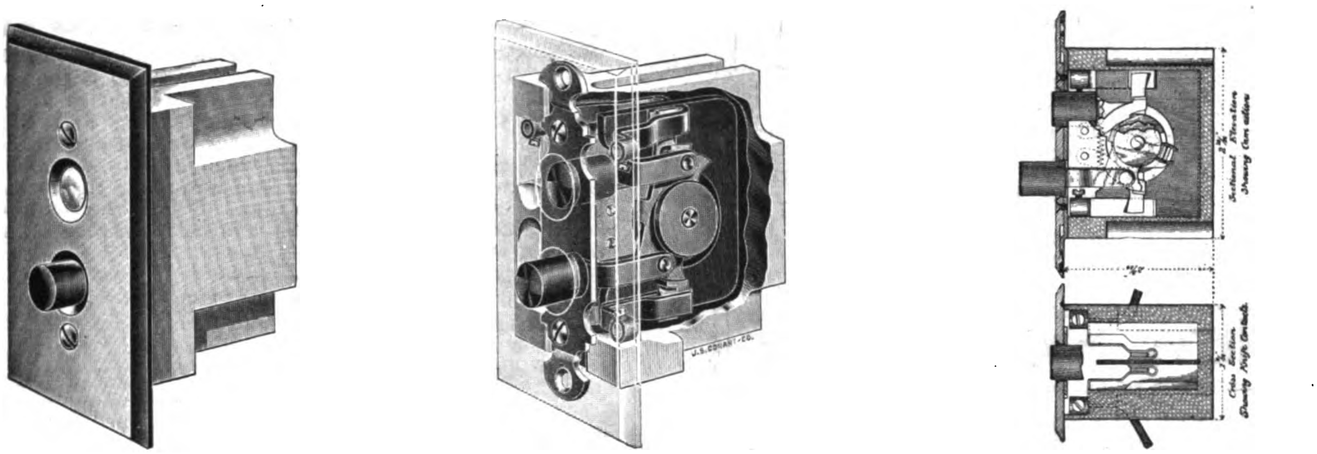
The Card Electric Company, of Mansfield, Ohio, inform us that their shops are crowded with orders, and that they look for a continuance of their present activity. The following is a list of recent orders taken by the Card Company: Seven 125 h. p. motors, to Deere & Co., Moline, Ill.; one 22 k. w. generator, to U. S. Baking Company, Charlestown, Mass.; two 25 h. p. motors, to H. J. Heinz Company, Allegheny, Pa.; one 20 k. w. dynamo, to Hoover Bros., Lima, Ohio; two 30 h. p. motors, to Raton Coal and Coke Company, Raton, N. M.; one 30 k. w. generator and one 4 k. w. dynamo, to the Shelby Electric Company, Shelby, Ohio; two 15 h. p. motors, one 10 h. p. motor and two 5 h. p. motors, to Massillon State Hospital, Massillon, Ohio; one 150 k. w. generator, to Elwood Street Railway Company, Elwood, Ind.; one 10 h. p. motor, to Toobelman & Co., Galveston, Tex.; one 15 h. p. motor, to the Ohio and Pennsylvania Coal Company, Cleveland, Ohio; one 10 h. p. motor, to the Cleveland Pearl Works, Cleveland, Ohio; one 40 k. w. dynamo to the Phalanx Silk Mill, Jersey City, N. J.; two 1,800 gal. plating dynamos, to Bennett & O'Connell, Chicago, Ill.; one 10 h. p. motor, to A. F. Spitler, Mansfield, Ohio; one 12½ k. w. dynamo, to the Garre Lumber Company, New Orleans, La.; one 12½ k. w. dynamo, to William Bailey & Son, Cleveland, Ohio; one 15 h. p. motor, to the Cambridge Iron and Steel Company, Cambridge, Ohio; one 40 k. w. generator, to the Wolverine Manufacturing Company, Detroit, Mich.; one 15 k. w. dynamo and one 7½ h. p. motor, to the Link Belt Machinery Company, New Orleans, La.; one 7½ k. w. dynamo, to Sport Plantation, Mt. Airey, La.; one 7 k. w. dynamo, to Eiseman Bros. & Co., New Orleans, La.; one 40 k. w. generator, to Decorah Electric Light Company, Decorah, Ia.; one 7 k. w. dynamo, to J. P. Roof, Strongsville, Ohio; one 20 h. p. motor, to Diamond Electric Company, Peoria, Ill.; one 20 k. w. dynamo, to H. J. Johnson, Cleveland, Ohio; one 25 k. w. dynamo, to the Jewish Orphan Asylum, Cleveland, Ohio; also several smaller machines.

ANCHOR PUSH BUTTON SWITCH.

THE Anchor Electric Company, 71 Federal street, Boston, Mass., make a specialty of switches of all kinds, and their snap switches, electrolier switches, flush and push button switches, sockets and receptacles are enjoying deserved popularity.

The Anchor push button switch is illustrated in perspective and section in the accompanying engravings.

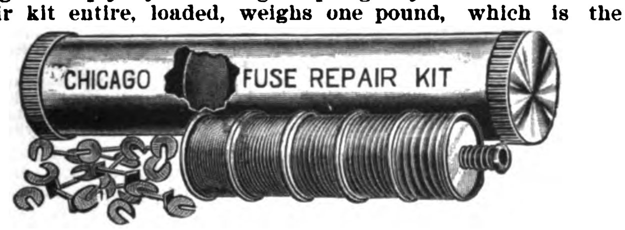
This switch is made on the same principle as the standard Anchor snap switch. The action is easy, yet the "make" and "break" is extremely quick. The contacts are heavy and the connections are easily made. Wires can be drawn through and fastened with switch in position, leaving no slack wire. These switches are made in "gangs" to order and finished regularly in nickel, with special finishes of copper, silver, bronzes, etc., when desired.



FIGS. 1, 2 AND 3.—ANCHOR PUSH BUTTON SWITCH. PERSPECTIVE AND SECTIONAL VIEWS.

THE CHICAGO FUSE WIRE REPAIR KIT.

THE Chicago Fuse Wire and Manufacturing Company, 154 Lake street, Chicago, and 853 Broadway, New York, have placed on the market the Chicago fuse repair kit. This device, illustrated herewith, is substantially made of brass tubing, finely nickel plated, with screw caps, and with a bottom placed about one-third the distance from one end. In the short end are placed fuse links, assorted, as may be desired. The long end accommodates the magazine containing five sizes of fuse wire, each on a separate spool and which may be changed simply by removing a spring key at one end. The repair kit entire, loaded, weighs one pound, which is the weight of one ordinary spool of fuse wire. The benefits to the lineman and repairman of this holder will be apparent at once, as it enables him to carry small amounts of a number of different sizes of fuse wire; also an assortment of fuse links, and all contained in a receptacle which is at once convenient and light, and which prevents the fuses from becoming damaged when thrown together with tools, etc., in the ordinary tool bag.



CHICAGO FUSE REPAIR KIT.

This device originates with the Chicago Fuse Wire and Manufacturing Company, and they expect to obtain a patent on it. The repair kit will sell at the popular price of $1 complete and filled, and extra spools to fit the same will be furnished at ordinary prices of fuse wire by the trade. The well known and established reputation of the above company in this line, and the long-felt want for just such an article, will doubtless make a large demand for this device.

SNOWFLAKE SOLDERING SALT.

The Grasselli Chemical Company, of Cleveland, O., have placed on the market their "Snowflake" Soldering Salt. This is prepared specially for electrical work from the purest materials and avoids the troubles experienced with acid. The salts are put up in half-pound, one pound and five-pound bottles, safely packed for transportation. A sample will be sent on application.

RECENT ORDERS OF THE RIDGWAY DYNAMO AND ENGINE CO.

The following is a list of recent orders received by the Ridgway Dynamo and Engine Company, of Ridgway, Pa.:

Schoen Pressed Steel Company, duplicate order, 50 k. w. direct connected to 12x12 engine; New York & Pennsylvania Company, fourth order, 16x16 simple engine; Doylestown & Willow Grove Railroad, two 14x23x18 tandem compound engines, direct connected to two 150 k. w. generators; City of McComb, O., one 50 k. w. lighting generator; Cavanal Coal & Railway Company, Poteau, N. Y., one 13x14-inch simple engine; Knoxville Iron Company, Briceville, Tenn., one 16x16-inch simple engine; Hamilton & Company, Steel Works, West Newton, Pa., one 40 k. w. generator; City of Milan, Tenn., one 13x14-inch engine; City of Opelousas, Tenn., one 14x14-inch engine; Black Diamond Coal Company, Coal Creek, Tenn., duplicate order, one 12x12 engine; Manning, Maxwell & Moore, New York City, 50 k. w. power plant, including direct connected engine and generator; United Gas and Improvement Company, Philadelphia, Pa., one 10x10-inch engine; Scranton Electrical Construction Company, Scranton, Pa., one 12x14-inch simple engine and one 17x18-inch simple engine; Pennsylvania Railroad Company, one 150 h. p. engine.

ADVERTISERS' HINTS

THE BURT MANUFACTURING COMPANY, Akron, O., advertises the Cross oil filter in capacities ranging from three to one hundred and twenty gallons and claim it reduces oil bills 50 per cent. or more. They are shipped by them on approval.

HENRY R. WORTHINGTON has established an office in New Orleans.

THE OTTO GAS ENGINE WORKS, Philadelphia, Pa., guarantee steady lights from dynamos run by their engines. They are built horizontal and vertical in sizes from 2 to 250 h. p.

E. F. WHITE, 116 Liberty street, New York, will send to those interested circulars descriptive of the White cooling tower and condensing equipments.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., illustrate one of their iron truss roofs. The purlins are covered with their anti-condensation corrugated iron roofing, which they guarantee will not drip in the coldest weather.

THE PRATT & WHITNEY CO.'S Boston office is now at 144 Pearl street.

THE AMERICAN RHEOSTAT COMPANY, Milwaukee, Wis., are well equipped to ship promptly and satisfactorily all orders for their rheostats.

THE AMERICAN MAINTENANCE AND ELECTRICAL COMPANY call attention to their unrivalled facilities for the repair of electrical machinery.

THE GRASSELLI CHEMICAL COMPANY, Cleveland, O., advertise "Snowflake" soldering salt especially prepared for electrical work of all kinds and sal ammoniac of 99¾ per cent. strength.

THE PURITAN ELECTRIC COMPANY, New York and Boston, publish a letter giving the result of a test of their enclosed lamp, which is most gratifying.

THE IDEAL ELECTRIC CORP., 13th and Hudson streets, New York, call attention to their 75-hour alternating lamps. Also their switchboards and new quick-break switches for high potential circuits.

THE CHICAGO EDISON COMPANY advertise a lot of second-hand boilers, engines, pumps, series arc dynamos and alternating current generators.

THE BELKNAP MOTOR COMPANY, Portland, Me., show very conclusively what may be effected by the use of the Chapman voltage regulator. The observations are made with a Bristol recording voltmeter, the charts of which are reproduced.

THOS. SMITH & CO., Worcester, Mass., supply armature core discs of any size and make a specialty of die making and metal punching.

THE ELECTRICAL EXHIBITION CO. OF NEW YORK.

Announcement is made of the incorporation of the Electrical Exhibition Company of New York City, to hold exhibitions of all productions of electrical and kindred industries; capital stock, $20,000; directors, Cyrus O. Baker, Jr., Leonard F. Requa, H. H. Harrison, G. F. Porter, J. W. Godfrey, J. G. White and C. A. Lieb, of New York City. These gentlemen were, nearly all, connected prominently with the Exposition which was so successful in New York City in 1896; and it is believed that their plans, if carried out, will make the proposed show in 1898 not less useful to the electrical arts and industries. Full publicity will be given to the plans as soon as they have been carefully matured.

NEW YORK NOTES.

THE AMERICAN ELECTRICAL AND MAINTENANCE COMPANY, of New York, owing to the greatly increased number of contracts for maintenance, have arranged for attendance to emergency calls that may be made at any time, day or night, Sundays and holidays included. The business in this branch has been thoroughly systematized and the company have a large force of efficient inspectors constantly on duty so that it is only necessary to call up 881 Franklin or 776 Brooklyn, to have an inspector investigating trouble within a very few minutes. So efficient has this service become that the business of the company has nearly quadrupled in the past few weeks and the company are to be congratulated on the success which has attended their well directed efforts in a work which is of great value to all owners of electrical apparatus.

HENRY R. WORTHINGTON has opened a branch office in New Orleans, at Nos. 713-717 Perdido street, and also in St. Louis, in the Century Building, 317 N. 9th street. The company has just issued a new general catalogue, No. 28, containing detailed descriptions of their pumping engines, steam pumps and hydraulic machinery. The new catalogue is replete with valuable information, including many tables, and should be in the hands of every steam user.

WESTERN NOTES

GEORGE W. PATTERSON has just been appointed Chicago and Western representative for the Gordon-Burnham Primary Battery and the Fibrite Company's Medbery switches and overhead railway appliances, with office at 1114 Marquette Building. Mr. Patterson is well known in the electrical fraternity through his past connections as "the busy man in Morse's office," and also by his very ingenious electrical Indian clubs (made famous at the Trocadero in 1893), with which he often entertains friends and the public. As a bright and industrious young man his equal is not often met, and with two such agencies we predict and wish him every success.

ST. PAUL, MINN., is advertising for bids for a city lighting plant. Also for bids for city lighting comprising 580 arcs, the bidder to receive a ten years' commercial franchise.

THE AMERICAN RHEOSTAT COMPANY, Milwaukee, Wis., owing to the large growth of their business, have found it necessary to increase their capital stock to $25,000. The rheostats made by this company are meeting with universal favor.

HURON, S. D.—Mr. H. C. Sterling, manager of the Huron Electric Company, bought out the old Huron Light and Power Company. He expects to be running Oct. 1 and is in the market for supplies. He has Thomson-Houston arc and alternating and is going to use artesian well power, transmitted two miles.

THE ELECTRICAL CONSIGNMENT AND COMMISSION COMPANY, of Cleveland, Ohio, have a well equipped shop at Hamilton and Coe streets, where they do a large and successful business in all kinds of new and second-hand electrical apparatus, and also do a large repair business. Having large and commodious quarters well fitted with the latest machinery, they are able to make repairs promptly and thoroughly and for reasonable prices.

MR. C. WILBUR WILEY, of the Wiley & Warner Electric Company, Beloit, Wis., finds the outlook for new business excellent. One of his latest enterprises in hand has been a 100 h. p. plant for Bedford, Ia., where he has been staying lately.

NEW ENGLAND NOTES

"LITTLE THINGS THAT COUNT."—This is the appropriate title of a neat pamphlet issued by Charles J. Root, of Bristol, Conn., describing his new Bristol and Elm City counters. Wherever it is necessary or desirable to keep accurate account of work done, such as on foot and power presses, weighing, measuring and automatic machines of all kinds, these counters will be found to meet the conditions exactly. Circular and price list will be forwarded on application.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. OCTOBER 7, 1897. No. 492.

THE NEW 70,000 H. P. CENTRAL POWER STATION OF THE METROPOLITAN STREET RAILWAY COMPANY, NEW YORK.

A STRANGER strolling through the streets of New York at the present time, and uninformed as to what it all meant, might imagine the city to be in a state of siege, or in the hands of a mob, judging from the earthworks thrown up on most of the principal avenues. But the purpose of the work is not warlike; on the contrary, its ultimate object is to give the city greater peace and quiet, and to enable its inhabitants to go from one part of the city to another with the least expenditure of time and money.

New York having from the first refused consent for erection of overhead trolley lines, left the street railway companies no other alternative than to go underground, and though they have, in the opinion of some, delayed action in the matter longer than might have seemed warranted, once the resolution having been taken, even their severest critics will have to admit that they are now proceeding with extraordinary diligence, and, indeed, the efforts which they are now putting forth are Herculean when one considers that practically in less than six months some half dozen of the principal lines of the city, embracing 55 miles of track, will be changed over to the conduit system. We have already described the details of the underground work now being carried out, so that we need not again enter into that part of the subject.

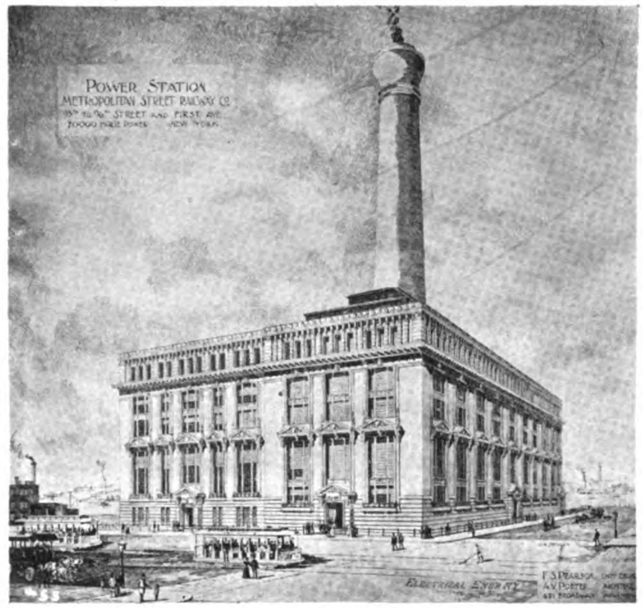


FIG. 3.—70,000 H. P. CENTRAL POWER STATION, NEW YORK.
(Proposed Design for Exterior.)

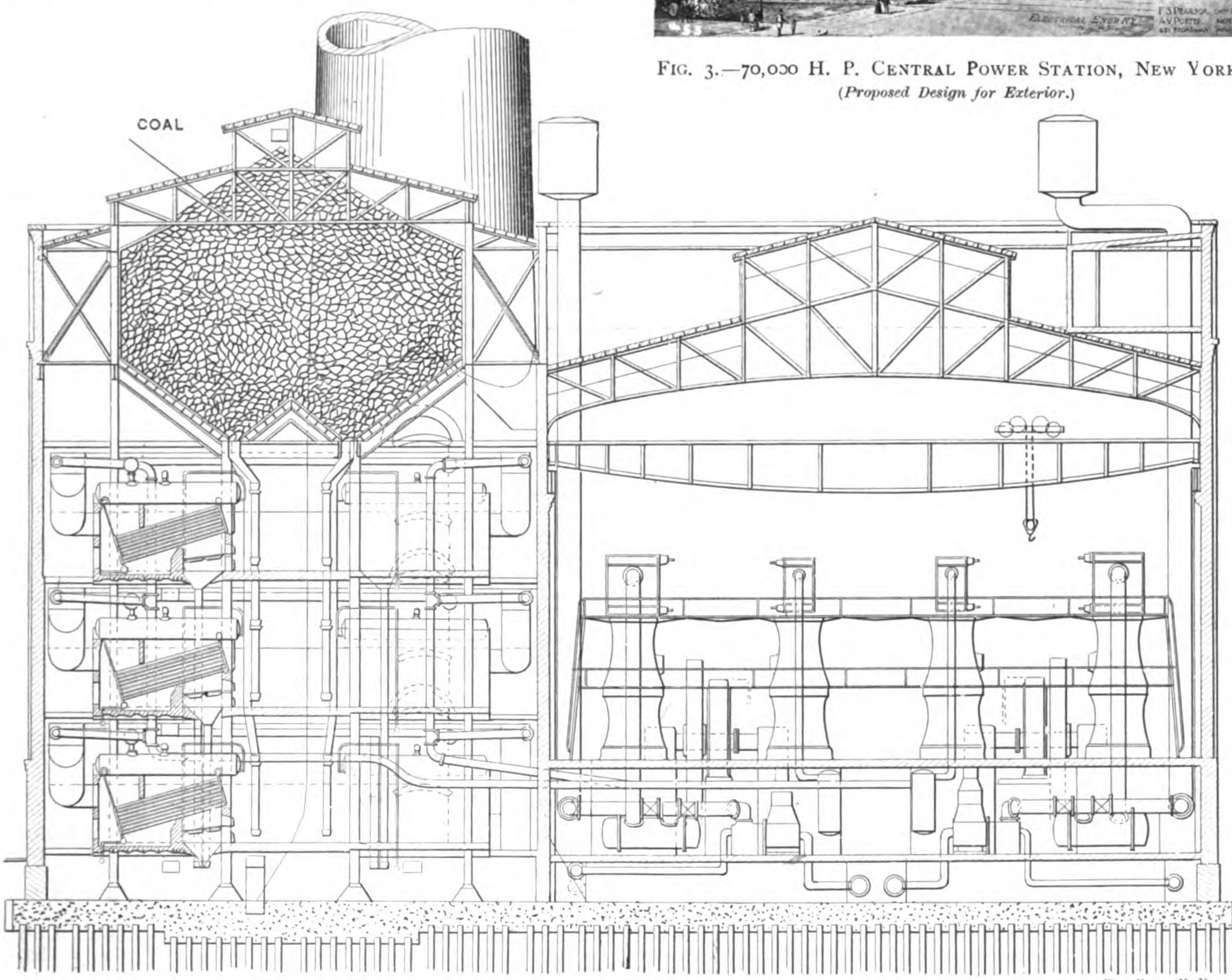


FIG. 1.—70,000 H. P. CENTRAL POWER STATION OF THE METROPOLITAN STREET RAILWAY CO., OF NEW YORK.—TRANSVERSE SECTION.

In their desire to inaugurate electric traction without the slightest possible delay, the Metropolitan Co. had naturally to make provision for the power to drive the cars. They have, for the present, largely increased the generating capacity of their power stations at 146th street, and at the old cable power house in East 26th street. Foreseeing the time, however, when the facilities at these stations would be inadequate, and having in view also the fact that the source of power subdivided in this way cannot be operated with the greatest technical or administrative economy, the engineers of the company have for several months past been working out the details of a power station intended to supply the company's entire railway system with current.

THE NEW POWER HOUSE.

It may be imagined that the power house, with such a load upon it, will be one of no mean proportions. Indeed, the plant, as at present designed, will have an ultimate maximum capacity of 70,000 h. p. In the accompanying illustrations, Figs 1 and 2, are shown, respectively, a section and plan of the proposed structure. While all the details have not yet been fully worked out, the plans as here shown represent the essential features of the new station, the erection of which will probably be begun within the coming year. Our engraving, Fig. 3, illustrates the proposed design of the exterior of the building. The new power house will be situated close to the river front, bounded by 95th and 96th streets and First avenue. This location is probably a little outside of the present center of distribution, but was adopted in evident contemplation of future extensions of the road. Aside from this, however, its location will, even at the present time, work very little to its disadvantage owing to the fact that current will be distributed at high potential, so that the question of copper outlay will be comparatively insignificant, as compared with the old method of distribution at 550 or 600 volts.

FOUNDATIONS.

The building will rest on a foundation of 8,000 piles, covering the whole site, measuring 201 feet by 270 feet. Upon these piles will be spread a bed of concrete, 5 feet thick, and upon this bed will be erected the walls of the building and the foundation for the machinery.

THE BOILER HOUSE AND CHIMNEY.

The boiler house is shown in the sectional view, Fig. 1. The boilers will be arranged in three tiers on either side of a central passage, with the chimney in the center. The eighty-seven boilers provided for in this way will be grouped in nests of two each, and each boiler will have a nominal capacity of 500 h. p., with a maximum of 800 h. p. The boilers will be of the water tube type, and provision will be made for forced draft, the blowers being located at the center of the boiler house opposite the base of the chimney stack. The chimney itself will be a landmark, and will be the biggest structure of its kind in the country. It will be not less than 350 feet high and 22 feet in inside diameter.

There will be a standpipe in the boiler house for each engine connecting to each of the three tiers of boilers, so that the size of the piping is kept down to a maximum of 16 inches. There will also be four independent risers from the engines for free exhaust.

As the entire system will ultimately depend for power on this station, special arrangements had to be made for the storage of an adequate quantity of coal to tide over any temporary stoppage of the source of supplies. For this purpose coal storage bins have been provided for at the top of the boiler house, with a capacity of 9,000 tons. The coal will be handled by conveyors, which will run out to the dock at the side of the station, from which it will be transferred directly from barges to the coal bin. The ashes will also be handled by conveyors.

THE ENGINES.

As shown in the plan, Fig. 2, the engine equipment will consist of eleven vertical cross compound condensing engines, directly connected to the generators. Each of these engines will have a nominal capacity of 4,000 h. p., with a maximum of 6,600 h. p., being arranged in two rows.

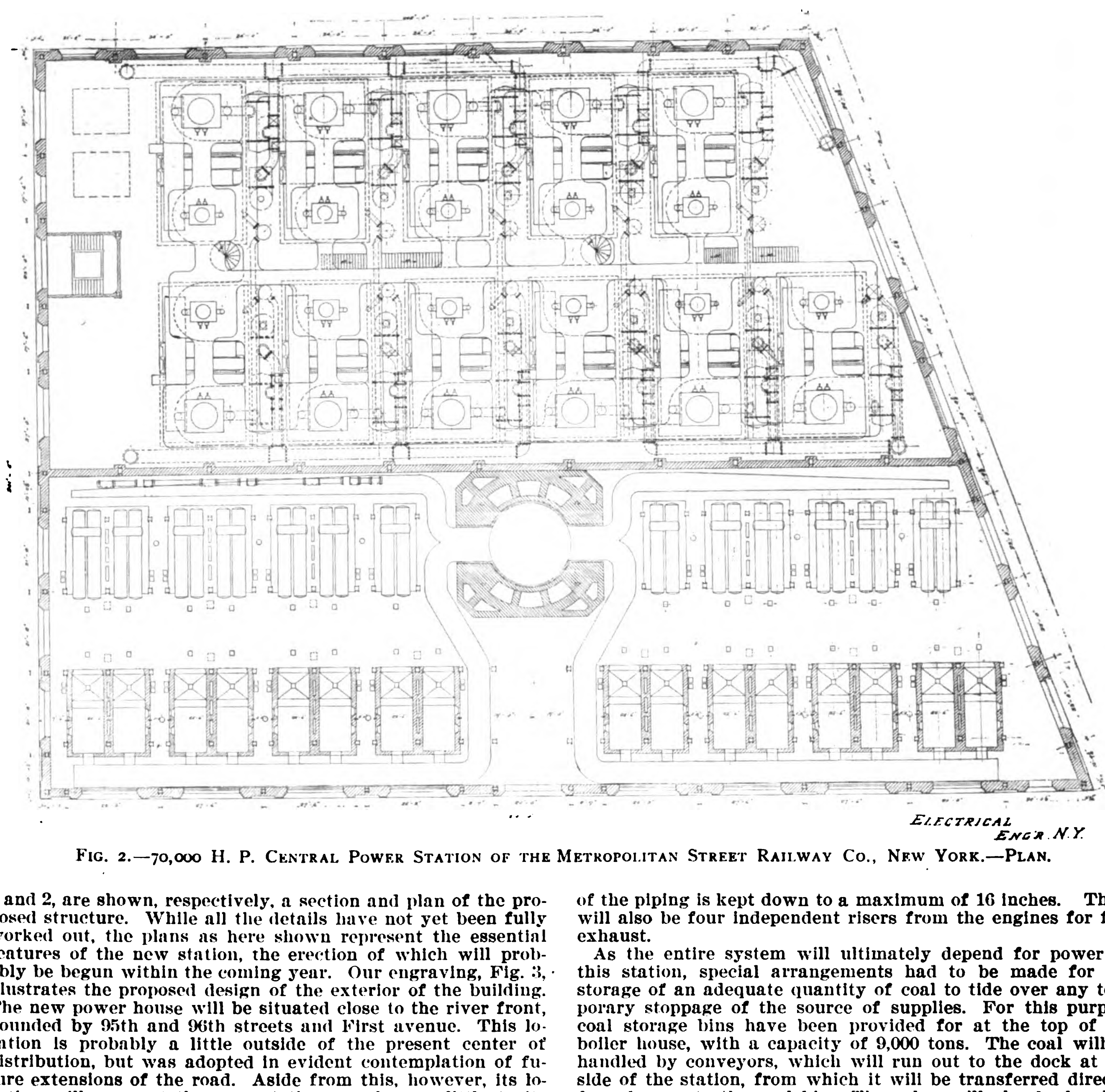


FIG. 2.—70,000 H. P. CENTRAL POWER STATION OF THE METROPOLITAN STREET RAILWAY CO., NEW YORK.—PLAN.

The exhaust mains from the engines will be carried to feed water heaters, situated below the engines, which will also be provided with surface condensers and independent air and circulating pumps. If for any reason it should be desired to work non-condensing, the exhaust can be led directly into four independent risers to the atmosphere.

THE GENERATORS.

As has alrealy been alluded to above, the present station will distribute current at a high potential. For this purpose eleven 3-phase alternating current generators will be installed, operating at 6,000 volts. The current from these generators will be led to sub-stations, located at proper points on the lines of the railways to be supplied, in which stations static transformers in connection with rotary transformers will convert the current to a pressure of 550 volts direct, which will be supplied to the conductors in the conduit.

The engine room will be traversed by a crane having a span of 110 feet, which will be able to handle readily the heaviest single piece of machinery which will be erected in the building.

The details of this, in many ways noteworthy installation, are being rapidly worked out by Mr. F. S. Pearson, chief engineer, and his staff, and its completion will mark an epoch in railway power house construction.

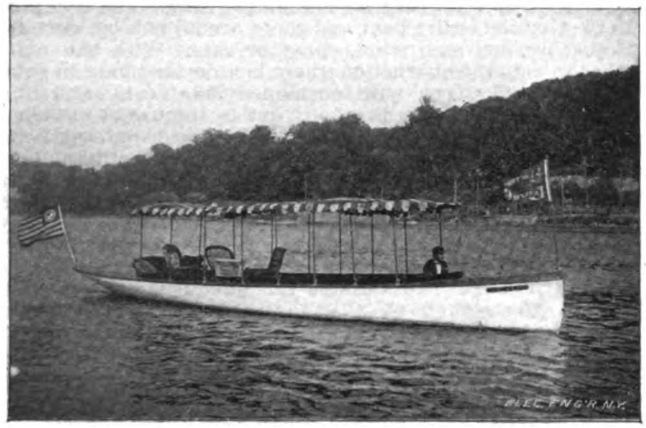
ELECTRIC LAUNCHES AS PASSENGER BOATS AT PLEASURE RESORTS DURING 1897.

DURING the past season the electric launch has steadily grown in favor as a passenger carrier at pleasure resorts and in connection with summer hotels. So much so, the list of launches in such service now numbers about forty-four, and they are distributed all over the country, from Portland, Me., to Tampa, Fla., and from Boston to Denver, with a number in the immediate vicinity of New York, two on Prospect Park Lake, Brooklyn, four at Pleasure Bay, near Long Branch, N. J., others at Winsted, Conn., and on Lake Hopatcong, N. J. The most popular type has been a 36-foot launch, with large seating space, protected by a light roof, adjustable side curtains, etc.

Because of the many advantages of electric launches, and their popularity as passenger carriers, the electric street railway companies of the country are steadily introducing them in such service at the terminals of their trolley lines, especially at the parks and pleasure resorts operated by the management of these railway companies. In the development of these pleasure resorts the attractiveness of electric navigation has made electric launches a paying investment. Each boat is usually fitted with a power equipment for a continuous run of 6 to 7 hours, which, including landing stops, is equivalent to a day's work of 10 or 12 hours.

The charging current for the batteries is supplied direct from the trolley lines, with a rheostat or resistance coil, to regulate the amount, but sometimes the high potential of 500 volts is reduced to the more convenient 110 volts by the introduction of a motor governor, thereby preventing the loss in the resistance coil.

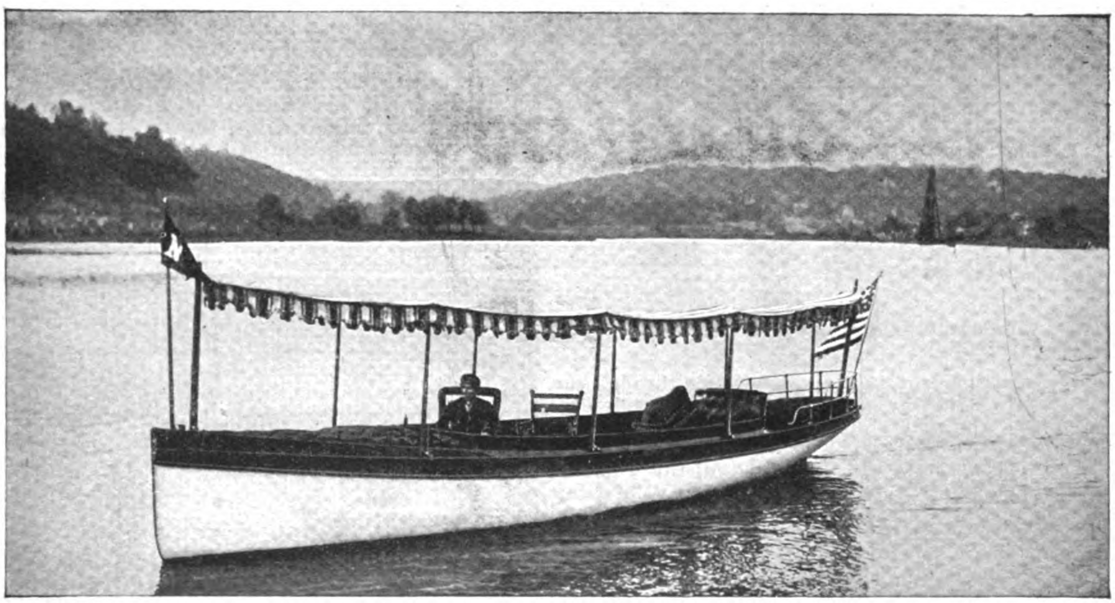
The nearly complete list of boats in such service is the following: Twenty-two boats operated at terminal parks of Akron, Bedford & Cleveland Railroad, Cuyahoga Falls, O.; Altoona & Logan Valley Electric Railway, Altoona, Pa.; Atlantic Coast Electric Railway, Long Branch, N. J.; Cincinnati, Newport & Covington Railway, Ludlow, Ky.; Milwaukee Electric Railway, Milwaukee, Wis.; Portland Railroad Company, Portland, Me.; Pueblo Electric Street Railway, Pueblo, Col.; West End Street Railway, Boston, Mass.; Irondequoit Park Railroad, Rochester, N. Y.



36-Foot Electric "Omnibus" or Passenger Boat.

Fourteen boats at public parks and hotel resorts: Breslin Hotel, Lake Hopatcong, N. J.; Colorado Hotel, Glenwood Springs, Col.; Prospect Park Lake, Brooklyn, N. Y.; Saranac Lake, Adirondacks, N. Y.; Tampa Bay Hotel, Tampa, Fla.; South Park, Chicago, Ill.

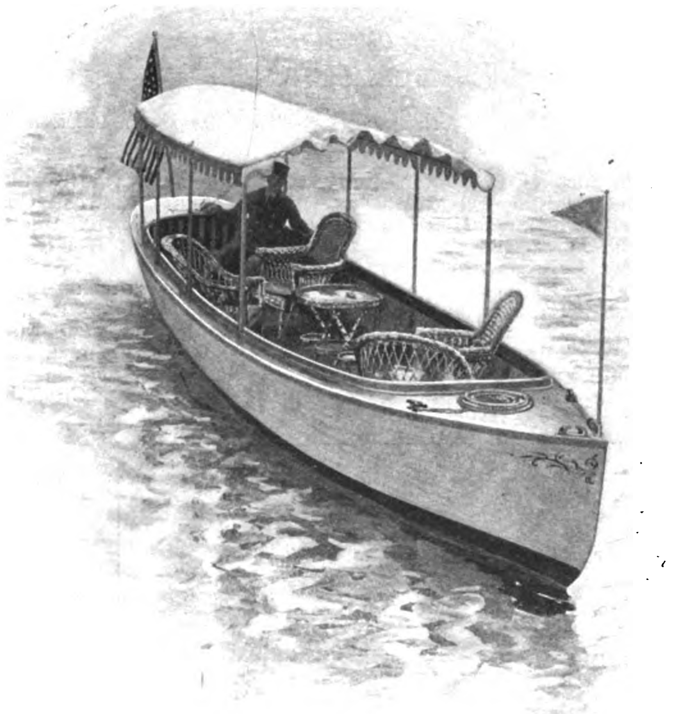
The Electric Launch Company, of New York City, has even gone so far as to rebuild some of the accepted type of launches by removing the side seats from the after part of the boat and furnishing this space with cane chairs, a large divan, and cane table. This feature improves the earning capacity very considerably, as the large boat becomes desirable for charter to small parties, who can be sociably seated together. When the maximum capacity of these large boats is desired, the chairs are removed and side benches are adjusted to accommodate the large number of passengers.



30-Foot Electric Launch Built for Wm. Jay Schieffelin, Esq., of New York.

"Omnibus" electric boats, answering the same public general uses as trolley cars, are, however, but one class. There is another variety also growing rapidly in number, namely, pri-

vate launches operated by their owners entirely for purposes of pleasure travel or as tenders to yachts or seaside residences. Such a boat is that here illustrated, a 30-foot launch, which is probably the most perfect pleasure boat of its kind and size ever launched and sailed. The entire boat space is available for easy chairs, table, hassocks, cushions, etc. There is a large upholstered divan at the stern, with a foot rest, like a steamer chair, and a reclining back with pillows. The floor is polished and covered with rugs. Both the decks are cushioned and the after deck is surrounded by a high brass railing, making both very cosy as lounging places. The awning extends over the entire boat and there are adjustable curtains to protect against sun, wind, spray or rain. With less real expense in actual construction, there is a decided gain in comfort over the older type with cushioned side seats. and limited floor space. This gain is wholly due to the use of electric motive power and to putting motor and batteries entirely beneath the flooring, adding at the same time to the stability and cleanliness of the craft. This disposition of the motive power, moreover, leaves all the space under both decks for storage purposes, and supplies, luncheon hampers, clothes, etc., may be put out of sight when a day's trip is being taken. Under the forward deck has been built a refrigerator with double doors opening into the boat through the bulkhead under the steer-



25 Foot Electric Launch.

ing wheel, and the refrigerator is supplied with ice through the hatch of the deck. For evening trips the awning and side curtains are all removed and several incandescent lamps fed from the boat batteries are strung from stem to stern.

This charming boat has been in commission all this summer on the Hudson River, in the hands of Messrs. Wm. Jay Schieffelin and E. G. Fabri, the owners, who may often have been seen cruising about in it off Scarborough. They have found its operation so simple and easy as to render wholly unnecessary the services of a boatman. For charging current they take the boat to the river dock of the Sing Sing Electric Company, about two miles off, and connect the batteries to wires from the exciter of a large alternating current dynamo there. With a rheostat the current is regulated to the proper amount and the boat is left to the station attendant with instructions to shut off current after a given number of hours, depending on the mileage made since the previous charge.

The mechanical details of the craft are simple enough to cause surprise. The motor, with self-contained thrust bearing, is directly connected to the propeller shaft. The batteries in one complete group are placed in the bottom of the boat in a rectangular space. The controller is concealed under the forward deck, operated by a wheel on a shaft extending through the bearing of the steering wheel. Under a small hatch in the flooring is placed a combination switch to connect the batteries either to the charging circuit or to the motor circuit. The battery equipment has sufficient capacity for a run of 50 or 60 miles at about a 6-mile rate per hour. The launch has, however, a larger power equipment than is usual for the length and has developed a speed rate of more than seven miles an hour for four hours continuously, or 6½ miles for nearly seven hours.

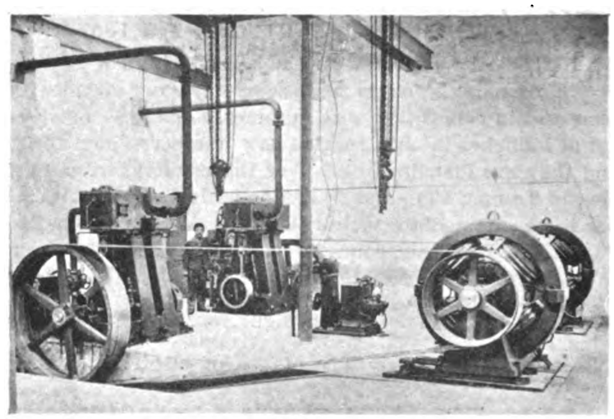
It will be gathered from the above that electric launches, despite the bad times of late years, have steadily increased in number and popularity and now, with returning prosperity, they bid fair to multiply very rapidly, not only because people have become familiar with them and can better afford them, or need them for business purposes, but because places for charging are far more numerous, methods of charging are more simple and current steadily grows cheaper.

STREET RAILWAY ENGINEERING IN EUROPE.

BY DR. G. H. B. ZAHN, C. E.

I. THE STREET RAILWAY SYSTEM OF ZURICH, SWITZERLAND.

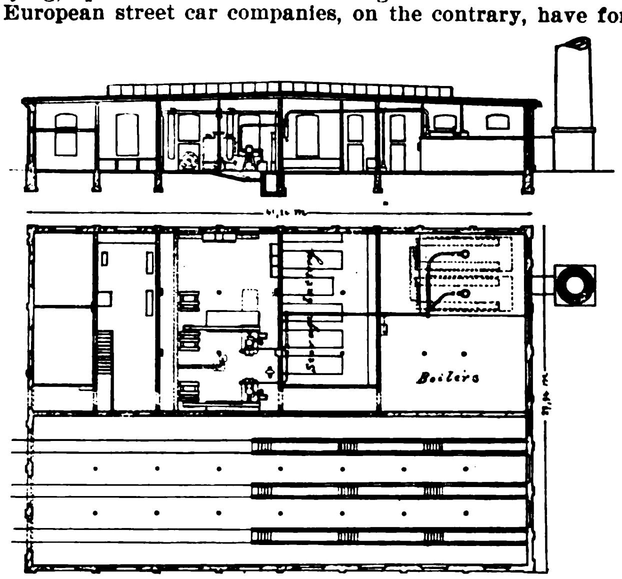
THE problems presented in the construction of electric railway systems differ in every case, and in order to obtain the best results the local conditions must be considered carefully. The building of a street railway in the United States has been so rapid that sometimes there has not been



Interior of Power House, Zurich Electric Railway.

sufficient time in which to give consideration to a number of apparently minor points that in the long run, however, are of very great importance for the successful, that is dividend paying, operation of the undertaking.

European street car companies, on the contrary, have for a

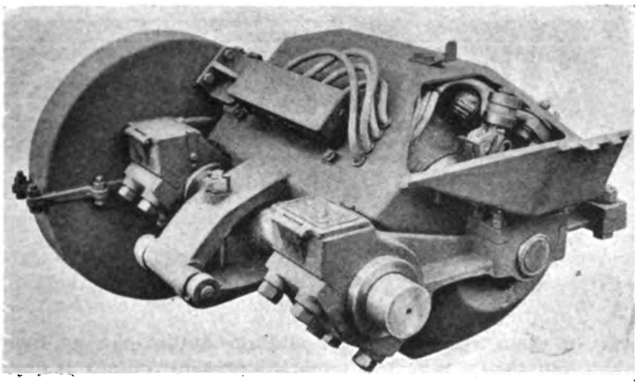


Railway Power House, Zurich.—Plan and Section.

long time been slow in adopting electricity for traction purposes, and the small impetus shown in some towns has been frequently checked by objections made by the municipal and government authorities. Though European electric street rail-

ways are, for that reason, not so numerous and of lesser magnitude than American enterprises, they nevertheless offer some good examples of careful engineering—especially financially—and warrant the attention of the street railway engineer as well as of the exporting manufacturer.

In the present article I wish to give a short description of a rather small street railway plant that for a number of years has been in successful operation in Zurich. Zurich, the manufacturing centre of Switzerland, has a population of about 120,000. The first street railway system was operated by horses and since 1894 a part of the horse lines has been con-

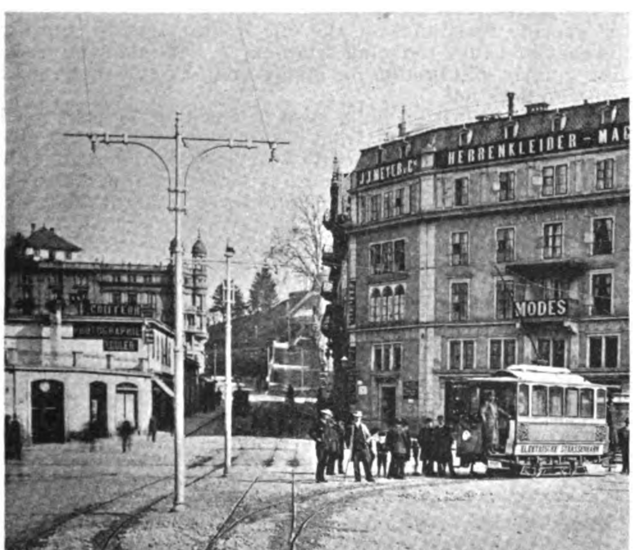


Oerlikon Electric Railway Motor.

verted to electric lines. On the present horse railway section, which is 5.6 miles in length, 27 cars are running in ordinary service, while nine cars are held in reserve. The electric section is 2.8 miles long, the number of electric cars regularly operated is 9, with 7 in reserve.

The roadbed and the type of rails required a good deal of the engineers' attention. The rails used on the former horse lines have not stood well the greater strain under the changed conditions, and in some cases a loosening of the rail joints has been noticed. The original rails, on the electric lines, will therefore be replaced by heavier rails. Ties are not employed on any of the construction. The road is single track, with eight turnouts, each being ninety feet in length.

Well designed iron poles are used in the city, while until



Electric Railway Construction, Zurich.

lately wooden poles with iron brackets have been employed for the overhead construction in the suburbs. All new work, however, is to be done with iron poles. The trolley wire which at first was 7 m.m. in diameter (about No. 1 B. & S.), is of hard drawn copper and placed at a height of 18 feet above the ground. A heavier wire corresponding to No. 0 B. & S., will be used in the future, and the span wires will be of steel and from 0.2 to 0.24-inch in diameter. In the overhead construction insulating fittings of porcelain and gutta-percha are used exclusively.

The power station equipment consists of two Galloway boilers, with heaters which supply steam to two vertical compound engines of 90 h. p. each, running at 240 revolutions per minute, and belted to the generators, whose speed is 450 revolutions per minute. There are two 66 k. w. Oerlikon generators and a 3 k. w. dynamo, the latter being used for charging storage cells. It is the intention, however, to replace the fast running dynamos by slow speed units coupled directly to the steam engines.

The most interesting feature of the plant is the use of a storage battery of 300 cells, of 245 ampere hours each. The battery is charged or discharged according to the load on the dynamo, and the corresponding voltage; the small 3 k. w. dynamo coupled to a steam engine is used for charging the end (regulating) cells of the battery. The installation of the battery which takes care of the fluctuating load and allows running the dynamos constantly at full load effects a saving of about 450 tons of coal annually, while the cost of maintenance of the cells is one-tenth of the amount saved on coal.

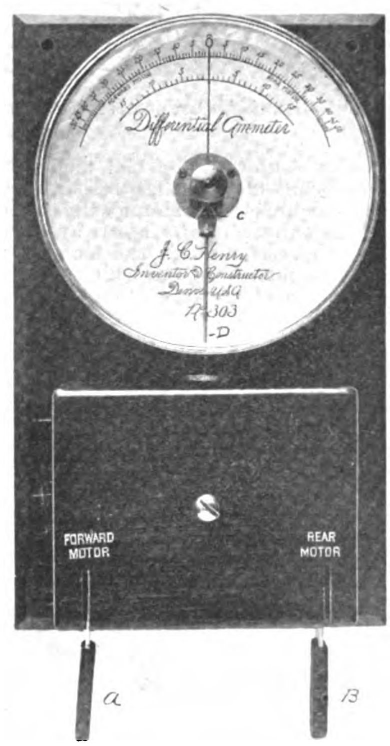
From the accompanying illustrations an idea may be gathered of the power house, the construction of the motors, and the overhead structure.

The cars, each of which is 18 feet long, and having a seating capacity for 12 inside and standing room for 7 on each platform, are equipped with 17½ h. p. motors. The maximum speed is limited to about 9.5 miles per hour. The cost of motive power per k. w. hour is 2.7 cents; the cost per car mile 2.5 cents. These figures include fuel, water, labor and light repairs on the power station equipment, but do not include depreciation. To the depreciation fund are passed annually: For the road construction, $2.56 per 1,000 car miles; for each crossing, $10; for the overhead structure, $45 per 1,000 car miles; for the power station, 2 per cent. of the original cost; for the cars, 3 per cent. of the original cost.

HENRY'S DIFFERENTIAL AMMETER FOR STREET CARS.

This "almost human" instrument is the result of a great deal of experimenting on the part of Mr. John C. Henry, of Denver, Col., one of the pioneer electric railway men. Its aim is to surround electric railway cars with additional safeguards and refinements.

Its main object is to indicate to the motorman or car in-



Henry's Differential Ammeter for Electric Cars.

spector just what the motors are doing and to sound an alarm when either of them is out of condition or is being abused by carelessness. The needle is influenced in opposite directions

by the currents in the separate motors. When the motors are absorbing the same amount of energy the needle stands in the center, as shown in the accompanying engraving, Fig. 1. Should the motors, from any mechanical or electrical cause, work unequally, the difference is indicated by the pointer.

To illustrate, suppose there was trouble with the rear motor so that it absorbed 5 amperes more current than its mate; the needle would point to figure 5 on the enlarged or lower scale on the right hand of the dial. If it is desired to measure the current absorbed by either motor separately the switch handles A or B may be moved to cut out the motor coils which represent the corresponding motor. In such cases the instrument acts precisely as a single ampere meter.

Connected with the instrument, as shown in the diagram, Fig. 2, is a specially wound vibrating bell, arranged so as to ring when the motors become unbalanced from any cause, or when they are being abused with an abnormal current. The

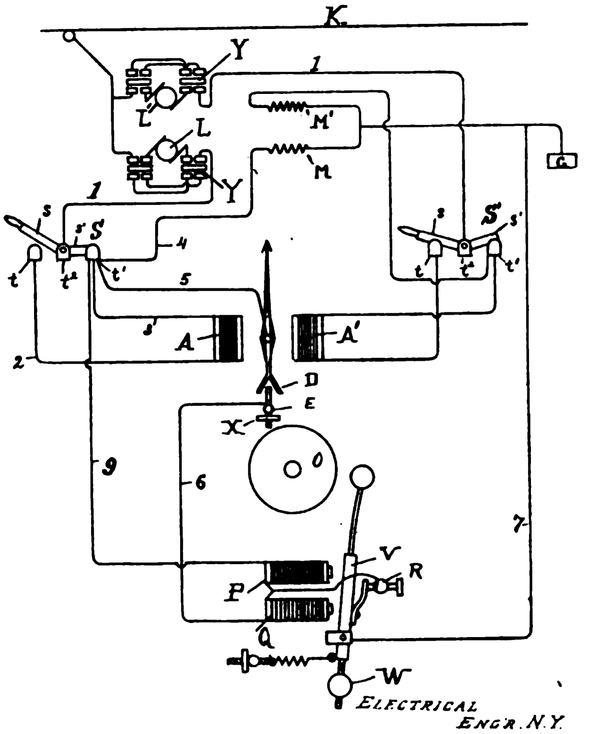


FIG. 2.—HENRY'S DIFFERENTIAL AMMETER.

arrangement is as follows: The bell magnets are wound in parellel with two coils of very high resistance wire the terminals of which are connected in shunt with the motor field magnets. One of the shunt circuits is always closed. When an excess of current passes through the motor fields sufficient is shunted through to make the bell ring. The other shunt circuit is normally open at the fork C on the dial. By screwing the circuit closer D upward, this fork, which is connected with the pointer, will make contact therewith so that when the motor becomes unbalanced the bell also rings. The instrument is also made without the alarm attachment in a portable form.

Numerous different kinds of trouble which motors are heir to can readily be located by electricians familiar with the action of galvanometers and knowing the different motor combinations while watching changes in the instrument when the controller is in different positions. Mechanical defects, such as tight bearings, improperly adjusted brakes, etc., are also readily detected, as they are certain to indicate abnormal or unbalanced conditions.

NO CHICAGO TRACTION COMBINE.

A dispatch from Chicago, dated Sept. 22, says: At a meeting held in a law office in the Monadnock Block yesterday, Anthony N. Brady and Thomas Ryan of New York were told finally and once for all that under no circumstances would the Chicago City Railway enter into a "combine" of the street traction interests of Chicago. Last night Brady and Ryan left Chicago and will join Messrs. Elkins and Widener in Philadelphia, where they will talk over plans which failed.

When the quartet of Eastern magnates reached Chicago, they thought they held a club over the head of the Chicago City people in the shape of the General Electric franchise, which they carried by permission of J. P. Morgan. They thought this would be sufficient to force President Wheeler into a combination which had for its object not only the control of all the street car lines of Chicago, but the abolition, wherever possible, of transfers. But within twenty-four hours after their arrival in Chicago Alderman Mangler went before the grand jury and told the story of the attempt to bribe him to vote for the General Electric. With this obstacle in the way the Eastern magnates were powerless, and when the officials of the Chicago City Railway said "No!" there was nothing left to do but to return home.

MISCELLANEOUS

ARC LAMPS AND THEIR MECHANISM.—II.

BY H. FRANKLIN WATTS.

THE SLIDING CONTACT.

THE sliding contact of our lamp is another bug-bear necessitated by the presence of a carbon rod. If the latter can be done away with, the sliding contact can go too, and who will shed a tear, but from the present outlook it does not appear that the sliding contact will slide away from us for many years to come, especially in out-door lamps. There are perhaps 500,000 arc lamps in the United States of the sliding contact double carbon type, operated by something like 1,200 companies. Estimating the present value of these lamps at the low price of $20 per lamp, we find that the average investment in double open arc lamps to be over $8,000 per company, equal to 400 lamps. As these lamps have depreciated in value at least 75 per cent. in the last ten years, the amount originally invested must have been four or five times greater, or about $32,000 per station.

The characteristic contact consists of a thin strip of spring copper pressing against the ever faithful carbon rod. If the pressure is sufficient to make good contact the rod is apt to stick, and if too light, then the rod will soon be tattooed from top to bottom. These lamps suffering from bad contact, in my judgment will always be benefited by the use of coal oil upon the rods, not for the purpose of cleaning them (in this respect it is useful, too), but to remain upon the rods. The resistance of the contact seems to be greatly reduced, notwithstanding the specific resistance of the oil; it also acts by lubricating the rods and thus reducing friction. A trimmer who uses coal oil regularly will lighten his labors and have cleaner rods than one who does not.

The Thomson-Rice lamp uses a form of contact bushing which is quite different from others, and good results are obtained. The alleged difficulties of the sliding contact have been greatly exaggerated and are more imaginary than real. The above contact has stood the test of 13 or 14 years of service, and is thought more of to-day than ever. There are those who prefer a flexible cord to a sliding contact. Where the movement is slight, as in the Thomson-Houston controller, a flexible cord is all right; but where a movement of 14 inches is required such a device is hardly the thing, as it is only a question of time when it becomes broken and causes trouble. Many of us remember our experience in the early days of the business with arc lamps having the rods so connected. The Thomson-Houston dynamo formerly had the same thing in the connection of brushes of the same polarity. Is there any one who desires to go back to these olden times and substitute a cord for the sliding contacts?

ARC LAMP MAGNETS.

In the design of magnets for arc lamps, electrical engineers seem in many cases to violate all law of magnetism. They will work out the magnetic circuits of dynamos for arc lighting with great care, but when it comes to the lamp, they seem to think that anything is good enough, and so we see straight plunger magnets having a core of ¼ to ½ square inch in section and wound with from 1,000 to 3,000 ampere turns. The magnetic circuit is usually very poor, consisting of nothing but a straight bar, with no return circuit at all, the main winding being upon one end and the shunt upon the other end, thus making a very poor arrangement as regards electric or magnetic economy. The magnetic density is in some cases as high as 125,000 lines per square inch, at which density the permeability of good wrought iron is not over 75.

As a lamp is supposed to respond to small variations in voltage, it is evident that the magnetization should not be car-

ried too high. This points to a more liberal use of iron or soft steel, a better magnetic circuit and a reduction of the excitation of the magnet. There are lamps having good magnets, but the tendency is to carry the magnetization rather high.

In the matter of insulation and construction of magnets, we can learn much from the original Brush. In these lamps we remember that the inner end of the main series winding is soldered to the brass bobbin on which the coil is wound. This at once disposes of two difficulties of more or less importance. First, it disposes of one end of the coil, which simplifies the connections and facilitates the removal of the magnets, and, second, it removes the danger of burning by grounding on the frame, as it is already connected with the frame; for it must be remembered the strain on the insulation is not merely the product of resistance and current, but may easily be 50 volts and in the case of a badly feeding or flaming arc, it may rise to 200 volts or more. With the increase in the number of lamps run in series there should be corresponding increase in the insulation.

SHUNT VS. DIFFERENTIAL LAMPS.

I believe the differential lamp can be made a safer lamp than the shunt, as the nature of their construction is such that they are less liable to break down, and also permit of a simpler mechanism. Their sensitiveness to current variations is often a great advantage, as during the last few hours of the run when the carbons are burned well down into the holders, the current can be reduced and a certain saving of power thereby effected.

Again, in cases of breakdown, the dynamo (but not all dynamos) can be overloaded by reducing the current, thus keeping a large number of lamps burning at a reduced candle power sufficient to comply with the terms of an iron-clad contract. The differential lamp also assists in the machine regulation, for a lamp that will burn a high arc with a high current, and a low arc with a low current, will constantly exert a certain regulating influence over the dynamo. In one or two systems, now obsolete, this action on the part of the lamp was so great and the machine depended upon it to such an extent that shunt lamps could not be successfully operated, the current continually surging from zero to 15 amperes and could not be held steady a moment. In other words, there were, and doubtless are now, in service arc dynamos incapable of operating shunt lamps to good advantage, and any machine inclined to surge will find the shunt the more difficult of the two to run.

There is, in particular, one well known lamp of this type that starts so promptly to burn a full arc on 4 or 5 amperes (it being a 10 ampere lamp), that unless the machine can build up very rapidly and has sufficient field winding to maintain its magnetic stability, the full load will be upon it while the field is still weak and the current low, and as a natural result the machine will be very apt to "flash," or to surge without flashing. However, in most dynamos that have survived until the present time, these considerations cut no great figure.

In a sleet storm, with carbons covered with ice, the shunt lamp is at a disadvantage, as these lamps will not start until the carbons come together, which is prevented by ice, while differential lamps having their carbons in contact will soon heat up and melt the ice, after which they will lift and burn. In freight warehouses, mills and factories where the constant vibrations would be apt to cause carbons to slip by each other, the shunt lamp is undoubtedly preferable. The shunt lamp is also better able to repeatedly start pointed carbons. However, the best way to overcome this difficulty of slipping by is to stop the machine from flashing and not to shut down after once starting.

The shunt lamp is certainly very popular, and this is no doubt largely due to the fact that these lamps require no extra resistance to be put in circuit when the lamp is cut out, while differential lamps are supposed to need one and usually have considerable either in the box or up in the chimneys. The contacts controlling this resistance are normally open, and being closed entirely by the shunt winding, it is necessary that the latter shall receive sufficient current to hold these contacts closed as long as the lamp is cut out. The resistance is, therefore, used to produce the drop to supply the shunt.

I believe this process of reasoning is entirely wrong and that there is no necessity for the contacts being normally open and being closed by the shunt, and that they can just as easily be closed by the weight of the parts and when there is no current on, the only requirement being that the cut-out winding have a certain resistance in excess of the main series, plus the carbons in contact, so that on first starting enough current is shunted around the series coil to open the contacts, after which the lamp will start. The extra resistance can be very low indeed.

In speaking of shunt and differential lamps it is rather amusing to observe that the differential lamps, which are sensitive to current variations, are nearly always used in connection with dynamos having the poorest regulators, while shunt lamps, which to a large extent are independent of current changes, are used upon dynamos having the best regulation and upon which there are no current variations. "'Tis true 'tis pity, and pity 'tis 'tis true."

CARBONS.

Electric light men are a good deal more conservative than they used to be and lamps will have to be a good deal cheaper than now to warrant station men in throwing out their old lamps and buying new ones. Then again the present lamps have many points in advance and which makes them cheaper to run than some of the more recent types. Take for example a lamp having but one set of carbons, using a ⅝ upper and ½ inch lower carbon; thus trimmed the lamp is good for fourteen hours. During May, June and July we only burn them 9 or 10 hours, leaving 3 or 4 inches of carbon unconsumed. What can we do with these carbons? We do not like to throw them away, as they cost from $7 to $9 per 1,000, and yet there is nothing else to do.

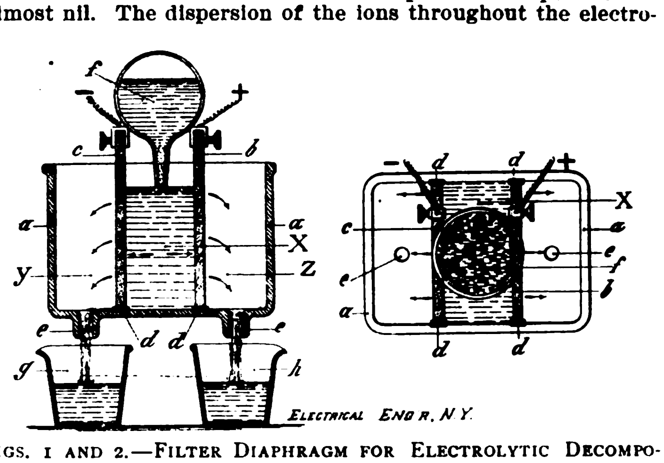
The same would be true if we only burned our lamps 7 or 8 hours, in which case there would be 5 or 6 inches of positive carbons to throw away. It is not enough to last another night and so the lamp must be retrimmed. It cannot be used in the second side of the lamp as a negative, as the lamp has no second side, and even if it had, the carbon is too large. In double lamps of the common type and using the same diameter and length for both upper and lower carbon, an unconsumed positive can be used as a negative and entirely consumed, thus securing the greatest economy, besides using a cheaper carbon.

Here, then, is a feature in favor of the old style double lamps. It is to be regretted that the designer of a certain lamp did not make the diameter of his carbons such that both could be 13 inches long instead of, as now, 14 inches and 12 inches. Many holders have been burned by not getting the ratio between the length of positive and negative carbons just right in trimming with short pieces. It is evident that if both can be of the same length, this is less liable to occur.

To the central station men I think that the cheapest carbon will be found to be a uniform length and size for top and bottom and for both sides and that the cheapest lamp is one that consumes just such carbons. Of course the enclosed arc is intended to overcome the difficulties above referred to.

FILTER DIAPHRAGMS FOR ELECTROLYTIC DECOMPOSITION OF SOLUTIONS.

The electrolysis of saline substances gives rise to the formation at the electrodes of elementary products termed "ions" which appear either in the solid, liquid or gaseous state, according to the kind of salt which is decomposed. When the electrolytic products are soluble in the electrolyte the ions as soon as produced become diffused throughout the salt solution and form, with the undecomposed salt, mixed solutions, which become gradually richer in electrolytic products and proportionately poorer in the material operated on until a point is reached at which the real output of the operation is almost nil. The dispersion of the ions throughout the electrolyte is the primary cause of the failures experienced in electrolytic operations.



FIGS. 1 AND 2.—FILTER DIAPHRAGM FOR ELECTROLYTIC DECOMPOSITION.

In order to overcome the difficulties above referred to and particularly to avoid the destruction of the products formed, recourse has been had heretofore to porous diaphragms, or

partitions of various kinds, dialyzers, bells, and other contrivances dividing the electrolyte into fractions or compartments respectively containing the anode and cathode. It has also been proposed to cause the ions to enter into a combination which is more stable than the electrolyte—that is to say, into a molecular group whose thermochemical value is higher than that of the compound submitted to electrolysis. By these means the limit of useful decomposition is extended and the electrolysis of the ions attenuated as well as their recombination, but the electrical resistance is increased, the operation is complicated, and absolute constancy of the electrolytic bath is not obtained.

To avoid all these difficulties M. L. P. Hulin, of Modane, France, has designed an electrolytic decomposition cell in which he employs what he designates as filter-electrodes. The principle of his new method is based on the fact that the products of electrolysis are formed only on the electrodes. In examining this phenomenon in the case of the soluble or liquid ions M. Hulin has ascertained that the extreme surface of the electrolyte by which the current enters the liquid—that is to say, the liquid layer without thickness which is the boundary of the bath in contact with the electrode—was exclusively composed of the product of electrolysis (ions). In order to seize hold of and separate this layer at the very moment when it is engendered by the electrolytic action he has adopted the idea of causing it to pass through the electrode itself to the rear of the electrolyzed bath by constructing the electrode in the form of a filter. By this means two simultaneous and continuous actions are established—viz., the electrolysis which produces the ions and the filtration which separates them from the electrolyte—and this by means of a single device, the filter-electrode.

The accompanying engravings, Figs. 1 and 2, show the arrangement in section and plan. In a rectangular tank a, of insulating material, are placed parallel to one another and at a certain distance from the ends two plates b c, of conductive and porous carbon, which make a tight joint d with the sides and bottom of the tank. The two filter-electrodes thus arranged divide the tank into the three main compartments, of which the two outer ones are provided with outflow-apertures è at the bottom, discharging respectively, into receptacles g h. The middle electrolytic compartment is kept filled to a constant level by the vessel f.

The solution to be electrolyzed is continuously supplied to the electrolytic compartment and penetrates the pores of the active faces of the filter-electrodes while undergoing decomposition, the ions filtering continually through and passing out at the inactive faces into the adjacent evacuation-compartments, where they are collected. This continual outflow of the ions through the electrodes is determined and regulated by a difference of pressure between the electrolytic compartment and the evacuation-compartments.

The inventor employs this apparatus to produce caustic potash from sulfate of potash, and for other like electrolytic decompositions.

THE NEW CANADIAN TARIFF ON ELECTRICAL GOODS.

The full text of the new Canadian tariff has been officially received at the State Department. The provisions regarding the duties on packages are fully set forth. All packages, such as bottles, jars, demijohns, casks, hogsheads, barrels, etc., all vessels capable of holding liquids, and every package being the first receptacle or covering, inclosing goods for the purpose of sale, shall in all cases in which they contain goods subject to an ad valorem duty or a specific and ad valorem duty, be charged the same rate of ad valorem duty as is to be levied and collected on the goods they contain, and the value of the package may be included in the value of such goods. Packages not otherwise specified being the usual packages in which goods are packed for exportation, according to general custom, are free of duty.

The reciprocal tariff clause provides that when the tariff of any other country will admit Canadian products on terms which are as favorable to Canada as Canada's terms are to the countries to which they apply, imported articles from that country may be entered for duty, or taken from warehouse for consumption in Canada, at a reduced rate of duty set forth in the reciprocal tariff schedule of the law. The benefits of this reciprocal tariff may be extended to any country which may be entitled to it by virtue of a treaty with Her Majesty.

Trusts and combines are provided against particularly. Whenever the Governor in council has any reason to believe that there is an existence, with regard to any articles of commerce, any trust, combination, association or agreement of any kind among manufacturers of such articles or dealers in such articles, to unduly enhance the price of such articles, or to promote the advantage of its manufacturers at the expense of the consumers, the Governor in council may empower any judge to inquire into the matter and report thereupon. He may compel the attendance of witnesses and may examine papers necessary for his purpose, and if he discovers the existence of any trust, and it appears that there is a disadvantage in the matter to the consumers, the articles in question may be placed upon the free list or the duty may be so reduced as to give the public the benefit of reasonable competition.

The portions of the new law that bear particularly upon the electrical trade and its kindred interests read as follows:

Wire, single or several, covered with cotton, linen or silk, rubber or other material, including cable so covered n. e. s., 30 per cent. ad valorem, 30 per cent.

Copper wire, plain, tinned or plated, 15 per cent. ad valorem.

Telephone and telegraph instruments, electric and galvanic batteries, electric motors, dynamos, generators, sockets, insulators of all kinds and electric apparatus, n. e. s., 25 per cent. ad valorem.

Electric light carbons and carbon points of all kinds, n. e. s., 35 per cent. ad valorem.

Carbons over six inches in circumference, 15 per cent ad valorem.

Lamps, sidelights and headlights, lanterns, chandeliers, gas, coal or other oil fixtures, and electric light fixtures, or metal parts thereof, including lava or other tips, burners, collars, galleries, shades and shade holders, 30 per cent. ad valorem.

Lamp springs and glass bulbs for electric lights, 10 per cent. ad valorem.

India rubber boots and shoes, and all manufactures of india rubber and gutta-percha, n. o. p., 25 per cent. ad valorem.

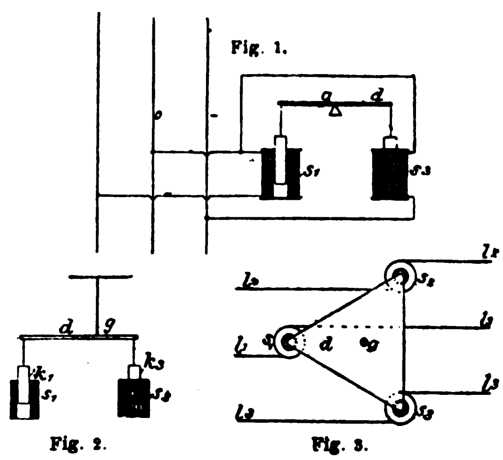
All goods not enumerated in this act as subject to any other rate of duty, nor declared free of duty by this act, and not being goods the importation whereof is by this act or any other act prohibited, shall be subject to a duty of 20 per cent. ad valorem.

FREE LIST—Platinum wire and platinum in bars, strips, sheets or plates, platinum retorts, pans, condensers, tubing and pipe, when imported by the manufacturers of sulphuric acid for use in their works in the manufacture or concentration of sulphuric acid.

Articles for the use of the Governor General.

APPARATUS FOR INDICATING A BROKEN WIRE IN A MULTIPHASE SYSTEM.[1]

Messrs. Schuckert & Co., of Nuremberg, are introducing an apparatus for instantaneously indicating in the central station a break in one of the line wires of a multiphase system. The apparatus is based on the principle of the well known differential gear, shown in Fig. 1. It is well known that two coils, as shown in the illustration, will retain their equilibrium just



Figs. 1, 2 and 3.

as long as the effect of each of the coils is equal. No matter what the absolute value of the currents may be, the equilibrium of the two coils is only disturbed when the balance between the two circuits is upset. Such an arrangement is well known, and is often used in three-wire systems to indicate

[1]Dingler's Polytechnisches Journal.

where the pressure of the one side is different from that of the other.

Messrs. Schuckert & Co.'s apparatus differs from the above in the fact that more than two coils are used and also that the frame, d, Figs. 2 and 3, are free to tilt in any direction. In consequence of this mode of arrangement the apparatus will indicate a break occurring in either of the conductors of the multiphase system, the different branches of which carry usually equal or nearly equal currents, because the equilibrium is disturbed when such a break occurs. In the three-phase system, three currents, l_1, l_2, l_3, are conducted around three coils. s_1, s_2, s_3, each possessing an equal number of turns. These coils are placed in the three corners of the triangle, d. An iron bar, K, dips into each coil. The three bars, k_1, k_2, k_3, are hung in the corners of an equilateral triangle, d, which is supported at its center of gravity, g. The equilibrium is preserved only as long as the three coils have currents of equal strength permeating them. It is destroyed as soon as one wire breaks. Then the triangle, d, dips, and at the same time causes a bell to ring in the engine-room. This apparatus may also be used for two-phase installations having three conductors. In that case, it will be only necessary to change the number of turns on that coil through which the current of the middle conductors passes. This new number of turns in the coil must be made equal to s|1.4, s being number of windings upon the other coils.

LORD KELVIN AT SCHENECTADY.

An interesting record of Lord Kelvin's visit to the Schenectady Works of the General Electric Company is the group photograph reproduced in the accompanying engraving. This shows Lord Kelvin in the center, with Lady Kelvin at his right, followed by Prof. Elihu Thomson and Mr. C. P. Steinmetz. Among the other familiar faces of the General Electric management will be recognized those of Messrs. A. L. Rohrer, S. Dana Greene, Eugene Griffin, E. W. Rice, Jr., and John McGhie.

LORD KELVIN AND PARTY AT THE GENERAL ELECTRIC CO.'S WORKS AT SCHENECTADY, N. Y.

THE SEARCHLIGHT AS A PRISON ADJUNCT.

A prisoner in the Trenton, N. J., state prison recently sawed his way out of his cell. He succeeded in getting to the roof of the main building, but was prevented from going further by the rays of an electric searchlight which brightened the roof about him and made it easy for the guards on the prison walls to see him in case he made the attempt. From 8 o'clock in the evening until 4 o'clock in the morning he sat upon the roof, in the shadow of a large ventilator, awaiting some chance that would direct the rays of the searchlight in another direction long enough for him to reach the walls, but the light was swung around for a moment only, at short intervals, and returned to the point which lighted the prisoner's path to freedom. He was captured eventually.

ROENTGEN RAYS

DISCHARGING POWER OF X-RAYS.

E. Villari has succeeded in bringing his various observations on the discharging power of gases traversed by X-rays under a simple and comprehensive theory. He showed some time ago that air retains the power thus acquired, even after it has been driven through a metal tube 10m. in length. The gas has become ionised, and a recombination of the ions is not brought about by the close proximity of an uncharged conductor. Air driven against a wire retains its discharging power. But if the wire is positively charged its power of discharging another positive body disappears. The negative ions have therefore become discharged. At the same time it retains its power of discharging a negatively-charged body, as might be expected. It may be deprived of its discharging power altogether by blowing it through the gap between a positively and a negatively charged wire, and also, as was previously shown, by subjecting it to the action of an ozonizing tube.

THE REFLECTION OF X-RAYS.

The alleged reflection of kathodic and Röntgen rays have been made the subject of two independent but closely-allied investigations by Prof. A. Battelli (Nuovo Cimento, v. 4) and M. P. Villarad (Bull, Société Francaise de Physique, 95). Prof. Battelli's conclusions are as follows: (1) It cannot be asserted that kathodic rays are reflected according to the regular law; (2) rays coming from the speculum of a focus-tube have the same properties as direct kathodic rays; (3) the same properties are possessed by rays coming from the anterior face of a very thin lamina, on whose posterior face kathodic rays impinge; (4) a pencil of such rays seems to be constituted of different kinds of rays which, when they fall on a thin body, appear to traverse it in somewhat the same manner that they would traverse a filter which allowed some rays to pass through more freely than others. M. Villard finds that kathodic rays that have fallen on a thin. metallic lamina, emerge in the form of a diffused pencil, whose general direction is normal to the lamina, but the phenomenon appears to be a kind of refraction. Reflection is more easily obtained, and the phenomena can be photographed; the reflected rays possess all the properties of kathodic rays, and are strongly deflected by the repulsive action of the kathode. Experiments show that this reflection, though evidently anomalous, is perfectly definite.

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THE DETROIT ANNUAL LIGHTING REPORT.

DETROIT has for some time past, owing to the activity of its former mayor, become known throughout the country for its tendency toward the municipalizing of every conceivable public necessity. One of the first projects of this kind carried out by that city has been a public electric lighting plant. When this plant was contemplated the wildest figures were given as to the low cost at which the city could be supplied from its own plant, but one year of operation sufficed to show that some things had not been taken into consideration, which were brought out very prominently in practice. The second annual report of the Detroit Public Lighting Commission, just published, only goes to strengthen our opinion that municipalities, as a rule, have nothing to gain by building their own plants. In saying this we do not in any way wish to cast any aspersions on the character of the management of the Detroit plant. On the contrary, we think the plant very well built and organized, and for that very reason it points a moral to other cities, which ought to make them hesitate before incurring similar obligations.

The second annual report, which we give more in detail on another page, shows a cash outlay of $64.19 per arc lamp per annum. We are glad to note, however, that the commission in figuring up the annual cost has taken into consideration the fact that by erecting its own plant the city has lost the taxes, which would be levied upon a private corporation, and the interest on the bonds used to erect the plant. They have also added a certain amount for depreciation. According to their own figures, therefore, the annual cost per arc lamp was $89.42 during the past year, as compared with $87.40 the year previous. In other words, the Detroit commission acknowledges the cost of an arc lamp to be, in round numbers, $90 per year.

We are glad to note that the Detroit commission is sufficiently frank and fair to its own taxpayers to include in its estimates the items of interest, taxes and depreciation above enumerated, but while giving them due credit for intended sincerity we must take decided exception to one point in their estimate of cost, and that is the amount of depreciation of the plant. It will be noted that the only part of the equipment which the commission has thought it worth while to single out as subject to depreciation is the boilers, for which it assumes a life of 25 years, and for which it adds an amount equal to 4 per cent. on their cost to the annual charge against the arc lights. This charge is probably not as high as would be allowed by a conservative steam user, but we will let it pass for the sake of the argument. Allowing the figures to stand as they are, therefore, does the commission pretend to assert that no part of the equipment excepting the boilers is subject to depreciation? They make a strong point of the fact that the entire system is kept in the best possible state of repair. But would a conservative business man lull himself into the belief that keeping his apparatus in good repair could stave off indefinitely the day when entire renewal will become necessary, either from the inevitable wearing out of the apparatus or from the necessity for replacing it by other apparatus of improved or more economical character?

It is fair to assert, therefore, that the Detroit commission is imbued with the belief that all of their buildings, all of their steam engines or dynamos, tools, machinery, conduits, towers and lamp posts, arc lamps, lines and cables will be just as good in every particular twenty-five years from to-day as they are at the present moment! The mere statement of this proposition ought, we think, to be sufficient to show its glaring absurdity. Besides, nowhere in the report do we find any mention of insurance! We believe it would not be too much to assume as a conservative estimate an average depreciation on the entire plant and insurance on station and equipment of less than 5 per cent. Figured on this basis, and taking the investment for arc lighting at the figure given by the commission, namely, $617,594, and subtracting the cost of boilers and real estate—which together amount to $94,532.12—we would have to add to the actual cost of maintaining the plant a charge of $26,153.05, bringing up the actual cost per arc lamp per annum to $102.49. Assuming depreciation and insurance at only 3 per cent. would still bring the cost up to $97.26 per lamp.

If it be argued that the city is now getting its light as cheaply as it can be gotten, and that a private company undertaking the same work could not do it at the same price and make a profit, we need only point out the fact that in the case of a private company a plant required for city lighting would only form a part of its equipment, and hence could be operated in conjunction with the commercial lights without entailing a proportional additional expense for superintendence, maintenance, etc.

The Detroit plant also points a valuable lesson which ought not to be lost to municipalities, and that is the obligation which cities must assume in order to carry out their schemes for electric lighting. At the present time Detroit's investment foots up nearly three-quarters of a million dollars, and according to its own figures it costs $337.88 per arc lamp, and $18.93 per incandescent lamp installed. When one compares these figures with the large majority of estimates put forth by advocates of city plants as to the cost of such plants, one does not wonder at the way in which taxpayers are beguiled into the belief that they can afford the luxury of a city plant.

This Detroit report is a sufficient answer to the papers read by Mayor MacVicar, of Des Moines, before the Mayors' Convention, and by Mr. Hunter, of Allegheny, before the National Street Lighting Association at Columbus, O.

UNSUSPECTED EFFECTS.

THAT many of the deeper and lasting effects of a great invention or innovation do not present themselves at once to notice, is a truism. It is obvious that as society advances in complexity, any change must produce effects that cannot be apparent until some time has elapsed, and that will even then remain obscure because of their intricate ramifications. Electricity has been peculiarly fruitful in changes of this nature, the end of which is not yet. Each great new electrical art has struck at the root of things established, and for fifty years past people have been puzzling out the consequences. So far as we are aware, no philosopher has yet worked out the conditions due to any one given factor, such as gunpowder, or the steam engine, or the telegraph, but there is material for a Buckle, a Lecky or a Spencer, for any competent man whose life should be spent in showing just what these great agencies have accomplished or set going.

Those who are in any degree interested in electricity cannot avoid having their attention called to the possible result of the improvements they are advocating, because, what will happen, is the first question asked of them, while everybody feels free to speculate as to the changes which may closely affect their own welfare. A recent example of interest developed is that taken in what may be fairly called the revival of water power. There is no doubt that the recent large utilizations of water power by means of electricity are making a profound impression on the public mind, and one can note many attempts to trace effects more or less remote. It is said that the capital which once went into railroad building is now seeking this new field. It is also asserted that one of the reasons for the lower price of silver and the greater profusion of gold, is cheap electrical water power available where fuel was terribly dear or unobtainable. The London "Spectator" now comes forward, and not satisfied with the evident transfer of industries from one point to another in a country, because of electrical water power, speculates on a readjustment of the relative conditions of the countries of Europe, due to the profusion of their waterfalls or the exhaustion of their coal beds. "The progress of electrical science has apparently changed the condition of industrial supremacy, and it appears as though the possession, not of coal fields, but of water power, will be the determining factor in the future." Hence the "Spectator" does not look cheerfully upon the permanence of the industrial positions occupied by England, Ger-

many and Belgium, which have no water powers of any extent and whose coal beds are yearly harder to win. But suppose great inventions made it possible to use coal and current more economically, by direct conversion and better distribution? That is quite possible and would relegate the changes dreaded by the "Spectator" to a very distant period again. Besides, the use of the great water powers discriminates just as much against the small ones as it does against coal. The development of Niagara makes power so cheap there that just as likely as not other water powers will in time be deserted for it because they cannot stand its competition. These and other considerations are of that complex nature referred to above; and while conjecture is easy and interesting, one must see the thing work out. The man who can make the shrewdest guess will reap most profit from the changes as they unfold.

A curious feature of this development of new situations is seen just now, within the coal trade itself. It is alleged that the prosperity of the anthracite trade is tied up with the future of the detached or single dwelling house. If people live in big hotels or large apartment houses, with a common source of heat, by steam or from the register, there is one furnace, which can be fed with a mixture of soft coal and anthracite screenings; but if people are living in houses of their own they want a good supply of anthracite. "So clearly do some of the larger firms see this," says the "Engineering and Mining Journal," "that they declare that all interested in the increased use of anthracite should make it a point to support by every means in their power the trolley lines that enable the workingman to get out of the confines of the city and to own a home." There's an unexpected but plausible suggestion for you. Evidently the centrifugal effect of the trolley in carrying back to the country to live the people who have been crowding into the cities, has allies and assistance that were not dreamed of, like all forces making for human welfare.

THE NEW YORK FIRE DEPARTMENT ELECTRICAL RULES.

THE new rules of the fire department of the City of New York, for the installation of electrical apparatus, for electric light, power and heat, just published, deserve more than passing comment. While the Fire Commissioners have adhered, in their latest rules, to the principles laid down in the National Electrical Code, their interpretations are probably more elaborate and their requirements more clearly defined than in any other publication of the kind which has come to our notice. This result was not entirely unexpected, however, as they gave evidence in their amendments of April 15, 1896, of what they intended to accomplish, before publishing a revision of the rules in their entirety. Many, if not all of the inconsistencies and ambiguities of the old rules have been eliminated, and although much new material has been introduced, the general effect is not so much productive of new methods of construction as it is of clear understanding of each requirement.

This is forcibly illustrated, for example, in Rule 3, relative to "Conductors from generators to switchboards, etc." Section A of the old rules required that such conductors be "In plain sight, on porcelain insulators, or easily accessible," and while it was, of course, impossible, in most metropolitan work, to comply with the first requirement, the second was so ambiguous as to cause much annoyance to engineers and contractors when they endeavored to determine, without special consultation with the inspection authorities as to what would be acceptable to the spirit and letter of the law. The new rule covering this work leaves no room, however, for speculation. It provides for five distinct methods of doing the work, with prescribed requirements for each, and whichever style is adopted, a high standard of safety will be the result.

Section A, of Rule 4, is a decided novelty, inasmuch as it is the first rule, published in this city, which makes compulsory the provision of a switchboard for each isolated plant and, while it is true that most of the modern plants are provided with switchboards, it must be admitted that heretofore they have been the result of engineering expediency and not of any law compelling their use. The necessity of a suitable switchboard in connection with an electric plant, as a safeguard against fire and personal injury will be unquestioned by all authorities on the subject, therefore the new rule is most timely, and as much as any of the others, indicates the thoroughness with which the work has been accomplished.

In Rule 13, Section D, we find that enclosed arc lamps are very properly exempt from the requirement of globe nets, which are never ornamental, and on this type of lamp are of little or no value. Rule 14 settles definitely the vexed question of service entrance, which should unquestionably be at the front of buildings, in order that it may be readily found, in case of emergency by firemen or others requiring access to it. The allowance of the tee-service connection to the buildings on either side of that entered from the subway is well within the limits of safety, while sufficiently liberal to be much appreciated by the lighting companies.

We note that Section B, of Rule 22, prohibits the use of brass armored conduit, which, on account of its fragile nature, has no place in the high standard of construction of the present day, although it is undoubtedly entitled to the credit of being the first insulated armored conduit, and is probably more than any other product of its kind, responsible for the high class iron armored conduits at present on the market. Sections E, F, G and H, of this rule, make ample provision for the safe use of flexible conduits which are absolutely necessary in the wiring of some completed buildings. Section M very wisely prohibits the use of any conduit having an interior diameter smaller than seven-sixteenths of an inch, thus removing all the trouble hitherto experienced in the drawing in of conductors (often an impossibility) in ⅜-inch conduit having three or four bends in a section.

Rule 23, applying to cut-outs, is most elaborate and, like the others, thorough in every detail. Section B of this rule allows ten amperes as the greatest amount of current to be dependent upon one fuse, thus eliminating the old inconsistenty of placing the limit at six 16 c. p lamps (three or six amperes), for one class of work and allowing from ten or more amperes on other groups of lamps that might be on the same main circuit.

Rule 25, in the shape in which it appears, fills a long felt want among engineers and construction men, in providing them with tables, showing in Section A the amount of current that may be safely carried on conductors of any size, from No. 18 B. & S. to 2,000,000 cir. mils; while Section B indicates at a glance the distance required between conductors of opposite polarity and Section C gives an elaborate table, showing the insulation resistance required on any circuit carrying from 10 to 6,000 amperes and operating with an electromotive force of from 50 to 500 volts.

These are an excellent set of tables and will be welcomed by every one working under the rules, but we believe the allowances of Section A might be a little more liberal without increasing the fire hazard, and we have no doubt that the Fire Commissioners will remedy this if it is brought to their attention.

Rule 28 removes the old absurdity of requiring that all arc lamps be supplied with current by conductors not smaller tnan No. 12 B. & S., a good rule when it was first adopted, but one that, until now, was persistently printed in all rules for years after it had outlived its usefulness, although it was seldom, if ever, enforced.

Rule 31 is another innovation, permitting, as it does, work that has always been done wherever electric current could be obtained, although it has been in violation of all rules published year after year prohibiting the use of incandescent lamps in series.

The new rules are in many ways a creditable production, and while they may, and probably will, give rise to controversy on some points, we believe that they will meet with general approval among electrical engineers as well as contractors. The adherence of the Fire Department to the principles embodied in the National Electrical Code shows not only sound sense on their part, but an appreciation of the fact that the National Code embodies all that is necessary to cover any kind of electrical construction and needs only to be amended from time to time to keep step with the advancement of the art.

NEW YORK'S ELECTRIC RAILWAY PROGRESS.

FOR nearly ten years past New York has been pointed at with the finger of scorn by the rest of the country for its lack of enterprise and facilities in the matter of surface street railway transportation. While there is barely a town of 10,000 inhabitants in the United States which has not had its electric railway system in operation for some time, New York, below the Harlem river; had no electric traction, if we except a half mile of trolley on 135th street and a few miles of underground conduit on Lenox avenue. But it would seem that the city is now making up for lost time, and, indeed, it may be claimed that by the first of January next New York will have the finest system of electric railways in operation to be found anywhere in the world; and, what is more, the work will be entirely underground, and thus remove the only objection which has ever been raised against the electric railway as a factor in the city's transportation. The faith of the Metropolitan Street Railway Company in their new system is well shown in the plans which they have under way for the erection of a monster central power house, the details of which are described on another page. With the experience of the last ten years at their command, the engineers of the company have designed a plant which we are sure will command attention the world over.

ELECTRIC LIGHTING

MODERN CONSTRUCTION AND MAINTENANCE OF ELECTRIC LINES.[1]

BY WILLIAM BROPHY.

NO one can deny that the best form of electric line construction is the underground system for the transmission of any form of electrical energy, except possibly the long distance telephone system, for here induction and retardation as yet offers an unsurmountable obstacle to the successful transmission of articulate speech over long distance lines when any considerable portion thereof is placed underground.

Electric lighting circuits in which is maintained a difference of potential of from one to ten thousand volts can be operated much better than when suspended in the air. The insulation of the underground cables and wires can be maintained at from one to six thousand megohms per mile, a figure that cannot be approached by any overhead line except where made up in the form of cables equally well insulated and protected by an outer covering of lead or some other equally durable material.

In the congested district of cities all electric wires should be placed underground, as there is no excuse now for maintaining them overhead on poles in the streets, an obstruction to travel and a great hindrance to the fire department in the performance of its duties.

Where an underground system is established it should be one pure and simple, not a mongrel one, where the mains and feeders are in the electrical subways and the house services distributed over the face and on the roofs of buildings or on unsightly distribution poles, in order to reach the various customers. There are several objections to this method of construction, one of the principal ones being that it tends to reduce the absolute insulation resistance of the circuit. While the insulation of the underground wires and cables is all that can be desired, that of these portions of the circuits connected thereto that are overhead, is insulated in name only, and neutralizes the good effects of the underground portions of the circuits. All services from underground systems should be continued underground until the interior of the building is reached.

Connections from underground circuits to points of consumption are made in various ways. In some cases subsidiary ducts are laid above the main ducts, in which are placed service wires, and from these connections are readily made to the buildings.

In other cases service connections are made in the manholes and from there run to the area under the sidewalk, and from these points the consumers are reached. In many cities the mongrel system before mentioned is used, in which case wires are led from underground conductors up the face of the buildings to the roofs, there to straggle from one point to another, providing they do not cross the streets. This method should not be tolerated anywhere. It has been the custom up to the present time to place transformers on the outer walls or roofs of buildings leading the primary wires from the underground circuits to them. A much better plan would be to place them in the manholes or in pits specially prepared for them; this would not expose the high potential primary wires to the accidental touch of firemen and others.

The author then described the two systems of underground electrical service in use, viz., the drawing in and the solid system. For fire and police telegraph circuits the solid system is far superior to any circuit of uninsulated iron wire, and not near as expensive as a drawing in system.

Unfortunately, underground systems as yet are the exception rather than the rule, and most of you for some time to come must deal with the question of overhead lines. In the majority of towns and cities these lines are running without any system or well defined plan, the aim seeming to be to reach the desired point in the shortest, easiest, cheapest, and oftentimes flimsiest manner possible.

Undoubtedly the best system of overhead lines are those supported on tall, shapely poles; on these should be fastened suitable cross-arms, with pins for support of petticoat insulators, the lines being fastened to these with tie wires. High and low potential wires should never be placed on the same pole fixture or cross-arm. Th pole brackets should not be fastened to the side of a pole between the cross-arms for the support of an extra wire; hard rubber hooks should not be screwed into the underside of a cross-arm for the support of another wire, when the arm is already carrying its full quota.

The owners of electric light and power lines make a pretense of using an insulating covering on them, but it is only a pretense; the so-called insulated wire used for overhead circuits of this character is but a flimsy, gauzy sham, so far as insulation is concerned. The insulation resistance of a high potential overhead line should not be less than 15 to 20 megohms per mile, yet I have known them to drop to less than one-half a megohm per mile after a soaking rain, and it is rarely that they reach from 2 to 5 megohms under the most favorable circumstances.

Better by far to use wires without any such coverings and proclaim the fact that they are dangerous and must be left severely alone. But better still would it be to compel the use of the highest grade of insulation on all such wires and protect them from the action of the elements by a suitable mechanical covering, such as lead. The same high grade of insulation can be maintained in overhead lines as is obtained in those placed underground, providing the same class of material is used. How long is the present style of overhead circuits to be tolerated and who will be the first to insist on the much needed improvement is more than I can tell, but that such a change is needed, no one at all conversant with the subject can deny. Almost perfect insulation of overhead and underground line is possible and all that stands in the way is the added expense and the apathy of the municipal authorities and the public, who good-naturedly suffer great abuse without even a murmur.

Thousands of dollars are spent by municipalities for the best kind of fire and police telegraph apparatus, which, by the way, has been brought to such a degree of perfection that failure to give and receive the proper signals would be almost unknown were the lines on which they are placed so constructed as to convey an unfailing supply of electric energy from one end of the circuit to the other, instead of dropping it by the wayside whenever a change in the atmospheric conditions takes place.

I will now take up the subject of line construction as it exists and is practiced in most municipalities. It is almost a universal practice to claim the top gain of all poles that have been erected for the use of the city or town in which they are located. This practice of placing municipal wires above all others was a very good one previous to the introduction of electric light and other high potential wires, as it reduced the possibility of interference with them due to the breaking of other lines. With the introduction of the electric light the same policy was pursued from motives of economy.

This practice has often proved to be a most decided false economy, and if persisted in will yet lead to serious and disastrous results. It should be discontinued also for the sake of the employés of the fire alarm department, as it exposes them to unnecessary and almost certain danger owing to accidental contact with wires that may or may not be active, as they have no means of knowing their exact condition. Many deaths and injuries have resulted from this cause and I fear there are more to come. In my own city some weeks ago one of the fire alarm linemen received injuries which did not result fatally, yet bid fair to leave him a physical wreck for the rest of his life.

Roof construction is one of the things that should be avoided in the fire or police telegraph system because it is not easily controlled; it cannot be readily inspected; it can be easily tampered with through accident or design. When exposed to coal gas from chimneys, galvanized iron wire is quickly attacked thereby and soon destroyed. One rusty, unsoldered joint will often offer more resistance to the passage of the current than all the instruments in the circuit.

Above all things, bare, uninsulated loops should be avoided in circuits; running such loops should be looked upon as a criminal act, because the instruments contained thereon are liable to be rendered useless at any time by being accidentally cut out.

The time when these lines should be constructed of uninsulated iron wire has long since passed, and it is the duty of every superintendent to so inform the proper authorities, and it is their duty to furnish the means to make the necessary change or bear the consequences.

Copper wire covered with the best grade of insulation and that in turn enclosed in a covering that will protect it from mechanical injury and the action of the elements is the cheapest in the end, as it reduces the cost of producing the necessary electrical energy and insures the correct working of the system at all times and if every mile of these lines could be placed underground, so much the better; at any rate, all that can should be so placed, as underground electrical construction and operation has long since passed the experi-

[1]Abstract of a paper read before the Mayors' Convention, Columbus, Ohio.

mental stage. It must be discouraging to the manufacturers of modern fire and police alarm apparatus to hear of repeated failures of the same, when from 85 to 98 per cent. of them are due to line troubles.

In conclusion, I contend that the present form of line construction for fire and police systems is a relic of barbarism and its continuance a crime against the public, because it invites almost inevitable failure at times when such failures mean the unnecessary loss of valuable property, the spread of flames beyond the ability of the department to cope with them, and, worst of all, the loss of human life.

ANNUAL REPORT OF THE DETROIT MUNICIPAL LIGHTING PLANT.

We have received the second annual report of the Public Lighting Commission, of Detroit, Mich., for the year ending June 30, 1897, containing in detail the operation of that city's electric lighting plant. Below will be found an abstract of the report, relating to the initial cost, cost of operation, etc. Illustrations and description of the plant were printed in The Electrical Engineer of July 29, 1896.

The City's Investment—The investment of the city of Detroit in its lighting plant now amounts to the sum of $729,222.73, and it is electrically equipped for 2,000 arc lights of 2,000 c. p. and 3,000 incandescent lamps of 16 c. p. intensity. The city, however, is operating only a total of 1,600 arc lamps, the balance of the equipment being held as a reserve.

The investment, for convenience in figuring, can be divided into two parts, arc plant and incandescent plant, making the division in proportion to the electrical output for the year. The output for the year was 2,980,412 kilowatt hours, of which 2,716,628 were for arc and 263,784 were for incandescent lighting. In this proportion the investment can be placed at $617,594.42 for the arc, and at $56,850.99 for the incandescent plants, divided into the following costs:

	Arc.	Incand.	Total.
Conduits	$ 66,413.15	$ 6,457.54	$ 72,870.69
Cables	28,420.75	2,761.44	31,182.19
Real Estate	57,532.12	5,592.88	63,125.00
Bldgs., Wharf, etc	99,431.91	9,666.70	109,098.61
Lines	110,548.66	10,747.48	121,296.14
Towers and posts	95,755.02	....	95,755.02
Arc plant	52,480.81	....	52,480.81
Incandescent plant	....	11,220.80	11,220.80
Steam plant	92,770.48	9,018.76	101,789.24
Railway track	9,054.75	880.85	9,935.60
Machine shop	5,186.77	504.54	5,691.31
Totals	$617,594.42	$56,850.99	$674,445.41
Belle Isle plant			7,821.85
Arc lamps and switches			46,955.47
Total investment			$729,222.73

Reducing the above costs to the cost per lamp, on the basis of the capacity of the plant, we have the following:

	Arc.	Inc.
Conduits	$ 33.21	$ 2.15
Cables	14.21	.92
Real estate	28.77	1.86
Buildings and wharf	49.72	3.22
Lines	52.27	3.58
Towers and posts	47.88	.....
Steam plant	46.39	3.00
Arc plant	26.24	.....
Incandescent plant	......	3.74
Railway track	4.52	.29
Machine shop	2.59	.17
Arc lamp and switch	29.08	.....
Totals	$337.88	$18.93

The arc lamps owned by the commission are 1,500 double carbon Brush lamps and 115 single carbon Adams-Bagnall lamps, at a cost of $46,955.47, or $29.08 per lamp, including switches.

Examination of these figures shows the investment comparatively high in several items, and they may be explained by the fact that in the construction of the plant it was thought best to have a reserve in several departments. The boiler capacity, as compared with that of the engines and electrical machinery, has a surplus of fully 75 per cent. Only about 80 per cent. of the real estate has been occupied, while the buildings are elaborate and extensive. In conduits there is a surplus of 66 per cent. in space. Therefore, there can be a large increase of the electrical and engine capacity of the plant and at the same time make a marked reduction in the costs of the total investment per lamp.

Cost of Arc Lighting—The year's operating expenses, amounting to a total of $110,141.38, can be divided between the arc and the incandescent in proportion to the electrical output. That chargeable to the arc lighting would be $100,393.15, which amount reduced to the cost of an arc lamp for one year shows the following relative figures:

Department.	Wages.	Stores.	Total.
Maintenance	$ 9.71	$ 2.87	$12.58
Executive	5.18	.62	5.80
Station	12.16	11.61	23.77
Trimming	13.86	5.03	18.89
Shop	2.65	.38	3.03
Injuries and damages	.01	.11	.12
Totals	$43.57	$20.62	$64.19

While the foregoing figures represent the cash outlay for an arc lamp for one year, they do not represent the total cost to the city.

The entire equipment is maintained in the best possible condition of repair, so that the cost chargeable to depreciation is reduced to a minimum. The only part that in time will have to be replaced in an entirety is the boilers, and experience has shown that their life should be 20 to 25 years. Four per cent. of their cost is therefore added to the cost of a lamp or $1.85 to the cost of an arc and 12 cents to the cost of an incandescent lamp.

The amount of the investment of the city for the year was $714,843.76, having an interest value at 4 per cent. of $28.593.75 per annum. Furthermore, had the plant been a private enterprise it would have paid the city its proportion of taxes. That this might be calculated the honorable Board of Assessors placed an assessed value on the city plant at $427,500. Computing the taxes of 1896 on this valuation at $15.54 for the city and at $3.13 for the state and county for each $1,000 of assessed valuation and we have the annual loss to the city in taxes of $7,981.43. The city has thus lost through municipal ownership a total of $36,575.18 of interest and taxes. Proportioning this in accordance with the electrical output and we have $33,338.91 for the arc and $3,236.27 for the incandescent costs. This additional arc expense being reduced to the single lamp for one year and we have $18.28 for interest and $5.10 for taxes, which, added, with the depreciation, to the cash cost given above, makes the total cost of an arc lamp to the city of Detroit for one year $89.42.

Lest unfavorable comparison may be made with the above costs of $89.42 with the $87.40, the cost used in the preceding report of this commission, attention may be called to the fact that the latter figure was made up of $68.52 cash outlay as compared with $64.19 for this fiscal year; and also last year there was no attempt to figure a depreciation or loss of taxes, and interest was figured only on the bonded indebtedness, which was much short of the actual investment.

Arc Lighting.—The arc output was used to light a daily average for the year of 1,564 lamps of 2,000 standard candle power intensity. The lights were burned on the all night schedule, burning an average of 10 hours, 23 minutes, July being the shortest month, with an average of 7 hours, 13 minutes, and December the longest month, with an average of 13 hours, 30 minutes. The arc lighting machinery was in operation a total of 3,790 hours, 55 minutes.

STREET LIGHTING BY CONTRACT AND BY MUNICIPAL OWNERSHIP.[1]

By JOHN McVICAR, MAYOR OF DES MOINES, IA.

An interesting compilation of statistics on street lighting by electricity issued by the American Society of Municipal Improvements, shows, among such other information, that 171 cities in the United States contain 187 public and private electric lighting plants, and operate 30,802 2,000-candle power and 11,572 1,200-candle power arc lamps and 251 50-candle power, 4,718 32-candle power and 7,026 16-candle power incandescent lamps, lighting 4,893 miles of streets.

Of those cities operating municipal plants, Kendallville, Ind., shows the lowest price, $30, and Tacoma, Wash., the highest $100 per annum, for 2,000-candle power lamps. Of those lighted by private contract Cheyenne, Wyo., pays the highest rate, $162, Minneapolis being next, with $150 per lamp.

The average rate paid for 2,000 candle power arc lamps by contract with private company, for all night and every night service in 29 of these cities is $106.85; by municipal plants in

[1]Abstract of a paper read before the Mayors' Convention, Columbus, O.

9 cities, $66.26. The average cost, moon schedule, by contract, is $95.70. By municipal plant, $56.67.

Some twenty cities use incandescent lamps in connection with arc lamps. The price of incandescent lamps seems to vary as greatly as that of arc lighting. New York, under contract for all and every night 16 c. p. incandescent lamps, pays $25 per year; Seattle, $21.60; Pittsburg, Kan., $9.60. Under municipal ownership Jacksonville, Fla., pays $15, and Fort Worth, Tex., $9.27 for all night 32 c. p. lamps.

The largest amount paid for street lighting is by New York City, which has 3,255 1,200 c. p. arc lamps and 25,450 gas and naphtha lamps, and 68 16 c. p. incandescent lamps, lighting a total of 625 miles of streets, and costing $488,000. The smallest amount expended for street lighting is Montpelier, Vt., which is lighted by one 30 c. p. incandescent lamp, costing $18 per annum. But 53 cities report having a method to determine the power of arc lamps. Only eighteen cities use iron poles, and but 65 use mast arms.

The most important question, and the first to be decided, is "How should a city obtain its supply of light?" I can think of but three methods to consider: First, by contract with private parties where competition will govern rates. Second, by the regulation of rates of private companies where a reasonable return upon the investment will govern. Third, by municipal ownership. Here the city's ability to manage will govern the cost.

To illustrate the possibilities under these methods, I will refer to the experience of the city of Des Moines. When, nearly two years ago, our present administration took charge of the city's affairs, we found 128 miles of its streets inadequately lighted with 167 2,000 c. p. arc lamps, moon schedule, at $96 each; 121 2,000 c. p. arc lamps, all night and every night at $126 each; 318 gas lamps of 16 c. p., at $18 each, and 900 gasoline lamps of 14 c. p. at $15 each per annum. Total expense, including lighting of city buildings, about $58,000 annually.

Conditions are favorable to low rates for light in Des Moines and Iowa statutes allow us to adopt either of the three methods above mentioned for obtaining our supply of light. We had four companies in operation in our city. The Gas and Electric Light Company, a branch of the gas trust; the Iowa Gasoline Light Company, a local institution; the Edison Electric Company (then owned by the General Electric Company); the Des Moines Water Power Company (Fort Wayne Electric Company, receivers). Steam coal costs in Des Moines 65 cents to $1 per ton, delivered. One plant was operating partially with water power.

Our contracts being about to expire, bids were advertised for, with the intimation that, unless a material reduction in the price heretofore paid was made, the city would establish a municipal plant. The bids received developed no material change in the price previously paid and showed a concert of action which indicated that while we had several independent lighting companies in operation, we were not receiving the benefits of natural competition. The fact that our city was without money or means to raise the money to build a plant because of its being at the constitutional limit of indebtedness, may have satisfied the local companies that they had little to fear from municipal ownership, and, as I will proceed to show ,they had reason to feel assured they could make such a showing before the courts of the cost of production as to prevent any material reduction did we attempt municipal control of rates.

Believing that our only hope for reduced rates for light lay in municipal ownership, our city council rejected all bids and under their direction I began an investigation of the question, "Can our municipality acquire and operate an electric lighting plant, which will give our city as good service at less cost than we now get by contract with private companies?"

When I undertook this task, I was about as well informed upon the subject as was the farmer's good wife, who asked her husband to bring home some electric plants that they might, by raising their own lights, save kerosene. In my verdancy I wrote for information to those whom I supposed knew the most. From but one electrical manufacturing company did I get any encouragement. The General Electric Company advanced considerable information which, they assured me, was from an entirely disinterested standpoint. Amongst other matters they sent me a copy of "Francisco's Fallacies of Municipal Ownership" and "Foster's Public Lighting by Municipal Ownership." It estimated the cost of erecting a 500 2,000 c. p. arc lighting plant, at not less than $250,000, and might reach $350,000, and that we could not hope to operate it at an expense less than the price we were then paying under contract, and advised us to continue to patronize the existing local companies. The Brush Company advised me that there was too much politics connected with operating municipal plants to allow of success (which was an exceedingly unkind insinuation). However, we received some encouragement from several engineers and contractors as well as from the officials of the cities of Rockford and Springfield, Ill. ,who quoted from their experiences.

Despite this discouraging information received, we invested in the services of a reputable engineer, who submitted estimates and specifications for a high grade modern plant, with a capacity of six hundred 2,000 c. p. arc and 1,200 incandescent lamps. The plant when completed was to operate 500 arc lamps and 1,200 incandescent lamps. When the bids were opened we were agreeably surprised to find that the lowest received came within the estimates of the engineer, and was as follows: Plant, complete (city to furnish site) $105,000, with an agreement to operate the same for a period of two, five or fifteen years, lamps to burn all and every night, for $65 per annum and for each additional lamp thereafter $60 per annum.

The city having no money, the contractors offered the following terms: The city to pledge $55,000 per annum from its lighting fund for a term of six years and four months, at which period the contractors would deliver the plant to the city for the nominal consideration of $1, and agreed to enter into contract to operate thereafter for fifteen years, all and every night, at not to exceed $65 per lamp. A second proposition, which was considered the better, and accepted, was that the contractor erect the plant and operate the same for a term of two years, at the rates above named, the city to levy a 2 mill tax, which the law provides for, to operate the plant for one year, and to apply from its general fund the amount usually appropriated for street lighting purposes for two years. These two funds will be sufficient to pay for the purchase and operation of the plant. The contractors agreed to continue to operate the plant five or fifteen years at not to exceed the above rates, and offered to substitute for arc lamps, if the council so desired, their horse power capacity in incandescent lamps.

Our plant is not yet built. When about to enter into contract the city was enjoined by the petition of a "prominent" taxpayer under direction and advice of the attorneys for the local companies, the plea being that the city was accumulating further indebtedness. The preliminary suit was decided in favor of the city. The contract has been entered into, but notice has been given that further suits will be brought immediately.

Preliminary to a siege that may be a protracted one ,our city council recently cut the rates for arc lamps to $65 and $75. Though these rates are $10 per annum more than the rate assured under municipal ownership, the companies say they will fight them in the courts; that they are lower than such service can be furnished.

ART IN STREET LIGHTING.[1]

BY ALLEN RIPLEY FOOTE.

If a person were to visit the various cities of the United States for the purpose of studying street lighting as it exists it is probable that he would find that but slight attention has been paid to art in street lighting up to the present time. There are indications, however, here and there that this subject is on the eve of receiving careful and scientific attention. It will occur to any thoughtful mind that the study of a problem of this kind requires for each city a person with natural adaptation for it. He should be so circumstanced by public position and support as to permit him to devote his time to his specialty, not only to follow out the best thought of his own mind, but to bring him into close contact and fellowship with persons similarly situated in other cities to the end that they may compare views, experiences and results with each other, thereby inducing a friendly rivalry between them for the purpose of demonstrating which can give to his municipality the best results in street lighting for the amount of money that the municipality expends for that purpose. Following this suggestion it is clear that such comparisons and such intercourse cannot be fully developed and utilized without the unifying effect of an association devoted to this special branch of science and art.

In days that we hope are past, one of the harmful methods in arranging systems of street lighting has been for the contracting company to obtain a contract for a number of lamps too small to do the work of the street lighting properly for the municipality, with a proviso that additional lamps be furnished as ordered by the street lighting committee or by council. The ordering of these additional street lamps has generally been done on the basis of enabling each member of

[1]Abstract of a paper read before the National Street Lighting Association, Columbus, O.

the council to gratify his personal wish, or that of some good friend in his ward, by placing lamps here and there without any proper consideration of their relation to other lamps or of forming a part of the street lighting system. Necessarily, therefore, this has resulted in a disjointed and unevenly balanced condition of street lighting which can hardly be dignified by being called a system.

In strong contrast with this method may be placed the work of a thoroughly competent superintendent of street lighting who makes a study of the subject as a whole; naphtha lamps, gas lamps, electric lamps, arc or incandescent, in numbers and in position calculated to make the effect of the whole symmetrical and the distribution systematic so that all parts of the city obtain light and the most light where it is the most serviceable. It would be well within bounds to say that a competent person studying this problem can take the appropriation made for any city, and by being permitted to lay out his system in a scientific way, and to make his contracts to cover sufficient periods of time, so that substantial construction can be afforded for the purpose, make the efficiency of the system at least 50 per cent. greater for the amount of money expended than the municipality has enjoyed under a non-scientific method.

It should require no argument to prove to the municipal government of any city that a well paid and a well supported superintendent of street lighting is one of the very best investments that can be made with the taxpayers' money to be included in the appropriation for lighting purposes.

Let any one who doubts this pass through a street and see how it is necessary to study the width of the street, the height of the buildings, the character of the obstructions to the dissemination of light, the intersections of streets, and the relation of one lamp to another so as to cause the diffusion of light to interlace itself in a way to make the light uniform and he will soon find that the opportunities for obtaining more evenly distributed and better service from the same number of lamps employed are almost unlimited. For practical as well as artistic considerations street lighting as an art should become a profession with its individual national association for its promotion.

CHAOTIC CONDITION OF OUR STREET LIGHTING SYSTEM AS TO COST, ETC.[1]

BY D. HUNTER, Sup't Bureau Public Lighting, Allegheny, Pa.

ONE of the most important and unsettled questions or conditions, of municipal government is that of lighting our highways, not with reference to what system shall be used, (the electric arc light having disposed of that phase of the question), but as to what price or cost shall be deemed equitable to the company furnishing, and the municipality receiving said lighting service.

In some cities the prices paid are such that it would seem that the companies furnishing the service must do so at some financial loss, in others the price is very reasonable, but in the majority of cases the cost is much greater than it should be, as the following will show:

PENNSYLVANIA.

	No. Lamps.	C. P.	Hours Service.	Coal per Ton.	Cost per Lamp per Year.	C. P. per Hour for 1 cent.
Philadelphia	6,500	2,000	4,000	$2.50	$109 to $146	498 to 734
Germantown	219	2,000	4,000	1.85	$135.00	592
Reading	400	2,000	4,000	1.60	105.00	762
Scranton	527	2,000	4,000	.50	91.25	877
Altoona	200	2,000	4,000	1.25	84.00	952
Wilkesbarre	203	2,000	4,000	1.50	80.00	1,000

We find upon comparing Philadelphia with Wilkesbarre that the first named city pays as much as $66 more per lamp per annum than the latter.

It would seem that the only important difference in cost of production that could appear against Philadelphia would be in the cost of fuel.

Allowing ten tons of coal per arc lamp per annum (which is ample), coal would cost in Philadelphia $25 and in Wilkesbarre $15, or a difference of $10 only, making net difference of $56 per lamp per annum, power of lamps and duration of service equal.

By the same method of comparison, Scranton instead of paying $91.25, or $11.25 more than Wilkesbarre, should get same for $10 (difference in cost of fuel) less than that paid by Wilkesbarre.

[1]Read before the Nat. St. Ltg. Asson.

OHIO.

	No. of Lamps.	C. P.	Hours Service	Cost of Coal per Ton.	Cost per Lamp per Year.	C. P. per Hour for 1 cent.
Cincinnati	1,510	2,000	4,000	$2.00	$84.90	942
Cleveland	400	2,000	4,000	1.25	94.80	843
Springfield	225	2,000	4,000	2.40	89.00	900
Toledo	700	2,000	4,000	2.00	90.00	890
Findlay	179	2,000	4,000	1.78	69.50	1,151
Columbus	990	2,000	2,179	1.00	74.50	585

Comparing costs between Columbus and Findlay it might seem that the prices paid by these cities were comparatively close, but after reducing same to a unit basis, such as number of candle power furnished per hour at a cost of 1 cent, we find that the City of Columbus pays almost double that of Findlay, and if we allow for the difference in cost of coal, the price is fully twice that of Findlay.

The higher price of coal in Springfield makes cost per lamp equal to that of Cincinnati, which is 20 per cent. below the cost in Cleveland, and nearly 50 per cent. less than the Columbus price.

The lighting service in Columbus is 2,179 hours per annum (moonlight schedule) and 4,000 in those under comparison.

ILLINOIS.

	No. of Lamps.	C. P.	Hours Service	Cost of Coal per Ton.	Cost per Lamp per Year.	C. P. per Hour for 1 cent.
Joliet	265	2,000	4,000	$0.80	$95.00	843
Peoria	414	2,000	4,000	1.25	98.00	816
Rockford	362	2,000	4,000	1.50	52.00	1,540
Springfield	346	2,000	2,179	.85	113.33	284

The above requires no comment.

INDIANA.

	No. of Lamps.	C. P.	Hours Service	Cost of Coal per Ton.	Cost per Lamp per Year.	C. P. per Hour for 1 cent.
Terre Haute	384	2,000	4,000	$1.55	$63.95	1,250
Richmond	180	2,000	4,000	2.00	90.00	890
Fort Wayne	260	2,000	2,250	2.00	120.00	375
Indianapolis	1,100	2,000	2,179	1.25	85.00	511

Comparing cost in Terre Haute with other Indiana cities, we find that Richmond, for a given sum, receives but 71 per cent., Indianapolis 41 per cent., and Fort Wayne only 30 per cent. of the amount of light furnished in Terre Haute.

MASSACHUSETTS.

	No. of Lamps.	C. P.	Hours Service.	Cost of Coal per Ton.	Cost per Lamp per Year.	C. P. per Hour for 1 cent.
Worcester	504	2,000	4,000	$4.00	$120.45	666
Fall River	499	2,000	4,000	3.50	155.12	515
New Bedford	190	2,000	2,179	2.00	138.75	314
Lawrence	96	2,000	4,000	4.00	100.00	800
Lawrence	114	1,200	4,000	4.00	90.00	890
Taunton	116	1,200	1,550	4.50	124.00	150

The figures given above show that Taunton pays 25 per cent. more money per lamp for 1,550 hours service than does Lawrence, for 4,000 hour service, power and number of lamps equal, and excess cost of coal in Taunton deducted.

In other words, for a given sum of money, Lawrence receives nearly six times that furnished the City of Taunton.

CONNECTICUT.

	No. of Lamps.	C. P.	Hours Service.	Cost of Coal per Ton.	Cost per Lamp per Year.	C. P. per Hour for 1 cent.
Hartford	648	1,200	4,000	$3.60	$79.20	607
New Haven	412	1,200	4,000	3.00	98.55	488

Difference in favor of Hartford 20 per cent., allowing for excess cost of fuel would make difference in cost of light 25 per cent.

The following will show the average candle power per hour furnished at a cost of 1 cent in 32 states:

	Ave. Cost of Coal.	C. P. per Hour at Cost of 1 cent.
Alabama	$1.92	791
Arkansas	2.30	390
California	7.00	449
Colorado	3.18	558
Connecticut	4.28	452
Delaware	2.32	728
Georgia	1.36	775
Illinois	1.19	654
Indiana	1.79	634
Iowa	1.57	641
Kansas	2.02	532
Kentucky	1.20	672
Massachusetts	4.05	375
Michigan	2.70	748
Minnesota	3.41	606
Mississippi	2.33	367
Missouri	2.54	667
Montana	4.00	440
Nebraska	2.21	465
New Hampshire	4.42	444
New Jersey	2.70	611
New York	2.87	627
North Carolina	3.30	521
North Dakota	6.35	666
Ohio	1.56	785
Oregon	wood	569
Pennsylvania	1.58	869
Rhode Island	3.85	459
Vermont	4.37	630
Virginia	3.07	651
West Virginia	.90	639
Wisconsin	3.13	630

The above table shows that the cities of Massachusetts for a given sum of money receive but 40 per cent. of the amount of light furnished in Pennsylvania. Connecticut gets 52 per cent., Rhode Island 52 per cent. and Vermont 72 per cent., making a difference of 32 per cent. in the New England states. Vermont makes the best showing, notwithstanding the fact that coal costs more in Vermont than in any of the other New England states.

The cities of Illinois receive but 75 per cent. of the amount of light furnished in Pennsylvania, and the average cost of coal in Illinois is almost 25 per cent. less than the Pennsylvania average.

Ohio stands at 90 per cent. as compared with Pennsylvania average cost of coal equal.

The foregoing cases are cited for the purpose of engaging, beyond question, the attention of those city officials having in charge the public lighting of their respective cities, and thereby causing them to at once proceed to investigate or compare the cost of lighting their city with that of others, bearing in mind that the only important difference in cost of production would be that of coal, which consumption may be fixed at 10 tons of coal per 480 watt lamp (2,000 c. p. so-called), burning 4,000 hours per annum.

For lamps of lower wattage, allow proportionate amount of coal.

In order to reduce all schedules and lamp power to a unit basis, the proper method is to find the number of candle power furnished per hour at a cost of 1 cent.

Although the term candle power is largely a misnomer at the same time all arc lamps using power to the amount of 480 watts are commercially conceded to be giving light of 2,000 candle power, so we must to a certain extent be governed by the term.

After careful consideration of the foregoing figures and comparisons, it would seem possible to determine what should be the maximum charge for this service, and the writer is of the opinion that the following prices are fair to the company and reasonable to the city:

For 480 watt (2,000 c. p.) arc lamps in service 4,000 hours per annum, $80 per lamp per annum.

For 325 watt (1,200 c. p.) arc lamps in service 4,000 hours per annum, $60.

Above prices based upon coal at a cost of $1 per short ton, and overhead construction.

Reasonable increase must be granted where authorities compel the use of ornamental iron poles and underground conduit work.

Where above prices cannot be obtained, or nearly so, it would be well for the municipality concerned to take immediate steps toward securing and operating their own electric lighting system, which, if but fairly well managed, will make the cost of lighting less than the figure given above, and at the same time prevent the almost endless disagreements between the municipal authorities and the local lighting companies, and it also places this very important class of municipal service exactly where it belongs, under the absolute control of the local authorities.

The City of Allegheny owns and operates its electric lighting system, and after an experience covering seven years, I am free to say that an offer of double its cost would not induce the city to sell the same.

Allegheny has a population of 125,000, covers 7½ square miles of territory, and is operating 1,100 full arc lamps, lighting 160 miles of streets and roads.

We also furnish all electric light used in the city buildings, 27 in number, using 4,000 16 c. p. lamps, and at this time are preparing to connect and furnish light in our city school buildings, which will add about 5,000 16 c. p. lamps, and make a total of 9,000 16 c. p. lamps operated from our station.

To the best of my knowledge, none of the cities mentioned in the comparative statements own or operate their own lighting systems, and the cost per lamp per annum, cost of coal, etc., are taken from statistics compiled by S. D. Greene, of the General Electric Company, Schenectady, N. Y.

Should any of the figures in tabulations be incorrect, making same known will confer special favor upon the author.

NEWS AND NOTES

MUNICIPAL GAS WORKS.—THEIR FAILURE.

Before the councils committee in Philadelphia considering the proposed lease of the city's gas plant, Wilson H. Brown presented figures showing that the average cost of labor per 1,000 feet of gas is 7 cents, while the cost at the city works is 21 cents. In an extended argument made by Charles H. Cramp, these views were presented:

In no case has a municipality or the government succeeded as a manufacturer, either in respect of efficiency of product or economy of production. No matter how honest or zealous the public officials may be who have responsible charge of such enterprises, they are placed at an inevitable and insuperable disadvantage, as compared with private enterprise. The old adage that what is everybody's business is nobody's applies with greater force to municipal or governmental workshops than to anything else whatsoever. No scheme of so-called "civil service" can avert the consequences of political vicissitude, with the resultant rotation in office and necessary derangement of working organization from time to time in the interests of patronage.

The manufacture and distribution of illuminating gas is a comparatively simple industry, but it requires the most approved business methods and the skill which comes from experience alone, quite as imperatively as more complex and diversified industries. Therefore, any system which is unavoidably subject to the vicissitudes of politics must be inferior in efficiency and economy to a system based upon the business conditions and operated under the business laws that govern all successful private enterprises.

Aside from the inefficiency and lack of economy inseparable from municipal or governmental industries, another evil of, perhaps, greater magnitude in the long run is the incapacity of the system to accommodate itself quickly or adequately to the ever varying needs of the people; the reverse of which is always true of private enterprise. At this time the insufficiency of the gas supply of Philadelphia is notorious, and each year's growth of the city aggravates the evil, because under the existing system it is simply impossible to expand the service along with the growth of demand. If private enterprise were dealing with the problem, the first and fundamental law of trade would at once operate to fill up the gap between supply and demand. No matter what outlay might be involved, private enterprise in any industry never lets its market go begging. Indeed, the universal tendency, as every one knows, is in the other direction. Again, the requirements, penalties, and bonds which the public imposes upon private enterprise engaged in producing things for public use create a degree and quality of responsibility which can never be put upon officialism.

THE NEW YORK TUNNEL RAILWAY.

Mr. O. T. Crosby appeared last week before the Supreme Court Commissioners, who are to determine whether New York shall build a tunnel railway. Mr. Crosby stated that the General Electric Company had made an offer to the Manhattan Elevated Road three years ago to install its system on the elevated for $10,000,000, but that he thought this could be accomplished to-day for less money. He also said that electricity as a motive power is cheaper than steam.

SOCIETY & CLUB NOTES

THE MAYORS' CONVENTION AT COLUMBUS, O., SEPT. 28, 29, 30 AND OCT. 1.

FIRST DAY.

THE Mayors' Convention met at the Auditorium on Sept. 28, when between 500 and 600 delegates from cities all over the country, consisting of mayors and councilmen, were called to order by Mayor Black, of Columbus, who acted as temporary chairman.

Governor Bushnell, of Ohio, welcomed the delegates and was followed by Mayor Collier, of Atlanta, who dwelt on the good such an organization as they were about to form might bring about in the improvement of municipal government.

The temporary organization was then effected by making Mayor Black chairman and H. J. Gordon, secretary. Each delegation chairman was then instructed to leave the list of his delegates with the secretary, and it was ordered that any city officer present at the opening meeting should be recognized as a delegate with full power. The session then adjourned to meet in the afternoon.

The afternoon session was brief. The delegates were slow in assembling and it was 2:30 before the proceedings began. There was not a very large attendance when the session opened, for the delegates loitered about the convention hall to inspect the exhibits and to talk over the proceedings of the morning and the plans for the future.

The session was devoted almost wholly to the reading of two papers. The first of these was by Joseph W. Stover, of New York, on "Telegraphic Systems For the Facilitation of Fire and Police Service." In this paper Mr. Stover gave a history of the fire and police telegraph systems in the United States and led up to the present state of the art.

Mr. Stover spoke of the necessity for modern electric systems of fire and police telegraph, and above all, of the necessity of securing the very best, both in material and construction, obtainable. He did not think that the lowest bidder was always the best bidder, neither did he think that there should be a law making it compulsory on the part of municipal bodies to award contracts to the lowest bidders, in the usual interpretation of the term—the bidder who submitted the lowest price.

Of this Mr. Stover said in conclusion: "The law or policy that requires municipal governments to award contracts or orders to the lowest bidder is demagogic in the extreme and has been a fruitful cause of trouble or loss. Fortunately for all concerned, the courts have held, in many cases submitted to them, in substance that the awarding of contracts to the lowest bidder does not necessarily mean the one who names the lowest price; that it is not only the right, but the duty of municipal officials in making purchases for a city's use to exercise their best discretion and judgment, and in the exercise of such judgment they should consider the reputation and responsibility of the bidder and the quality of the goods."

There was no discussion of Mr. Stover's paper, and a paper on "The Modern Construction and Maintenance of Electric Wires and Their Supervision by Municipalities," by Captain William Brophy, of Boston, followed.[1]

The convention then adjourned to the following day.

SECOND DAY.

The second day's morning session was given over to the reading of a number of papers, not devoted specially to electrical matters, as follows:

"Uniformity of State Laws Pertaining to Municipal Government," by J. A. Johnson, mayor of Fargo, N. D. "The Sterilization of Milk As a Municipal Health Protection," by Nathan Straus, of New York. "Organization of the City Government of Boston," by Mayor Josiah Quincy.

During the day the delegates were photographed in a group.

In the afternoon the delegates witnessed an inspection and review of the Columbus fire and police departments. It was the first time many of them had ever seen anything of the kind, especially upon the plan that the Columbus exhibition was given. It was a splendid display, and when it was finished, the visiting officials warmly congratulated Mayor Black and Director of Public Safety Williams on the efficiency of these two important departments.

TREASURER S. L. BLACK.
Mayor of Columbus, O.

PRESIDENT JOHN MCVICAR,
Mayor of Des Moines, Ia.

SECRETARY B. F. GILKISON.

OFFICERS OF THE LEAGUE OF AMERICAN MUNICIPALITIES.

Wednesday night the visitors were entertained by the secret societies of the city, the Elks, the Shriners, Junia Lodge, I. O. O. F., and the Knights of Pythias, with a round of social sessions.

THIRD DAY.

The morning session was consumed entirely by the reading of one paper, and an extended discussion that followed. It was upon "How to Obtain a Good Asphalt Pavement," by Mr. S. F. Peckham, of Ann Arbor, Mich.

The afternoon session was occupied with the discussion and final adoption of the report of the committee on constitution and permanent organization. The issue of municipal ownership which had invaded the convention on Wednesday became much in evidence while the adoption of the committee's report was under consideration. The opposition to this system of operating public supply services insisted that the selection of officers should be confined to mayors or councilmen, in order to prevent the selection of Mr. B. F. Gilkison, editor of "City Government," who was accredited with being a warm advocate of municipal ownership. The discussion of this part of the report at once became animated, even bitter. Mayor Quincy, of Boston, startled the convention by declaring that the municipality of which he was the head did not propose to subscribe to any association of municipal officials whose object was primarily the promotion of the personal interest of an individual. With this Mr. Quincy formally withdrew from the association and left the convention hall.

After an hour's discussion the constitution was adopted without material change from the draft submitted by the committee. The election of officers followed, resulting as follows: President, Mayor John McVicar, Des Moines; vice-president, Mayor C. A. Collier, Atlanta, Ga.; secretary, B. F.

[1] See page 328.

Gilkison, New York; treasurer, Mayor Samuel L. Black, Columbus; trustees, Mayor John Warner, Peoria; President of Council Fred A. Walker, President of Council C. M. Leitch, Wilmington, Del.

Detroit was selected as the next meeting place.

The constitution designates the name of the association as "The League of American Municipalities." This title was chosen so as to admit to membership Canadian cities, which in the intended interpretation of the title are construed to be American municipalities. The constitution also determines the complement of executive officers, fixing the basis of representation, the amount of dues, graded according to the population of municipalities, and limits the membership of the league exclusively to mayors and councilmen. A bureau of information is also established by the constitution.

The afternoon was devoted to a carriage drive about the city.

The evening session was opened with an address by Dr. Hartwell, of Boston, on the system of municipal or public baths as operated abroad. He was followed by Col. C. E. Waring, of New York, who spoke on "Municipal Street Cleaning." Mayor S. M. Jones, of Toledo, read a paper on the "Social Side of Life in Cities."

Mayor F. C. Pierce, of Marshalltown, Iowa, followed with a brief paper upon "Municipal Water and Light Plants," using as an illustration for his remarks in favor of municipal control the progress and showings of the service of his own city. The effect of the paper throughout was strongly in favor of municipal control of all public convenience furnishings.

The paper of Mr. Allen Ripley Foote, of Washington, D. C., member of the American Economic Association, upon "Private and Municipal Ownership of Water, Gas and Electric Lighting Works," concluded the evening's programme. The scope of this paper was of the widest possible nature, covering the methods pursued in investigating these conditions, the difficulties encountered, the results obtained and finally what might be expected with careful management in either instance.

The meeting then adjourned until the following morning.

FOURTH DAY.

The closing session of the convention was called to order by Mayor Black. The following papers were read:

"The Filtration of Water," by Edmund B. Weston, of Providence, R. I.; "The Relation of Mayors and Councilmen to Sanitary Problems," by Alex. Potter, sanitary engineer of New York City. Dr. Washington Gladden's paper on "The Federal Plan of Municipal Government," and papers by Professor Knight and Professor Morese were read by title only and ordered to be printed in the published reports of the convention.

Mr. A. J. Boardman then offered the following resolutions:

"Whereas, This national conference of mayors and members of city councils has been informed that the United States Department of Labor has undertaken an investigation of water, gas and electric lighting works, and a clear outline of the methods, form and purposes of this investigation has been given by Mr. Allen Ripley Foote, in a paper read before this conference under the title of "Cost of service to users and taxpayers, a proper basis for comparisons between private and municipal ownership of water, gas and electric lighting works"; and whereas, Hon. Carroll D. Wright, United States Commissioner of Labor, has announced that the object of this investigation is to enable municipalities and the citizens thereof to determine whether there is any economic advantage to consumers in the municipal ownership and operation of water, gas and electric lighting works; and whereas, such an investigation by the expert and impartial authority of the United States Department of Labor, which can reach every municipality in the United States, is sorely needed, and will have a vital and far-reaching influence in correctly guiding public policy on this question of paramount importance to all municipalities; therefore, be it

"Resolved—First, That this conference cordially approves of the investigation as set forth in Mr. Foote's paper, to be made for the purpose stated by Hon. Carroll D. Wright, United States Commissioner of Labor.

"Second—That the delegates to this conference tender to the United States Department of Labor, and to its duly accredited agents, their co-operation in every practical way to facilitate this investigation in their respective municipalities, and to make the information collected complete and accurate.

"Third—That it is the sense of this conference that the executive and legislative officers of all municipalities, and the managers of all public service corporations, should promptly and cordially do whatever may become necessary on their part to expedite the work of this investigation, to the end that through it statistics may be secured that will be accepted by all persons as reliable basis for comparisons."

After a lively debate the resolutions were adopted.

After passing a resolution of thanks to citizens of Columbus, the president announced the following list of honorary State vice-presidents:

New Jersey, Welling G. Sickel, mayor of Trenton; Virginia, Mayor W. R. Mayo, Norfolk; Illinois, T. J. Medill, Jr., mayor of Rock Island; Ohio, Samuel M. Jones, mayor of Toledo; Alabama, F. V. Evans, mayor of Birmingham; Georgia, S. B. Price, mayor of Macon; West Virginia, William F. Hite, mayor of Huntington; Pennsylvania, Robert J. Saltsman, mayor of Erie; New York, George E. Green, mayor of Binghamton; Massachusetts, H. A. Collings, council, Holyoke; Rhode Island, R. H. Ryder, council, Pawtucket; Connecticut, Frederick B. Farnsworth, mayor of New Haven; Indiana, W. M. Aiken, Jr., mayor of Evansville; Kentucky, George D. Todd, mayor of Louisville; Michigan, William C. Maybury, mayor of Detroit; Iowa, F. P. Pierce, mayor of Marshalltown; Colorado, T. S. McMurry, mayor of Denver; Minnesota, Frank B. Doran, mayor of St. Paul; Maryland, W. G. Mellinger, mayor of Cumberland; North Dakota, J. A. Johnson, mayor of Fargo; North Carolina, Silas P. Wright, mayor of Wilmington; Florida, S. N. Bronson, mayor of Lake Maitland.

The meeting then adjourned sine die.

MEETING OF THE NATIONAL STREET LIGHTING ASSOCIATION.

FIRST DAY.

The opening session of the National Street Lighting Association was held at the Chittenden parlors, Columbus, O., Tuesday morning, September 28, but no business was transacted, the sole action of the opening meeting being the instructing of the delegates to be present at the afternoon session, to be called at 4 o'clock. The delay in the opening was due to a desire on the part of the convention to permit the presence of as many of the delegates as possible at the initial session.

The meeting was called to order at 4:30 by Chairman B. L. Lambert, of New Haven, Conn., the attendance being extremely limited, owing to some misunderstanding. On motion a committee of three was appointed on credentials. The report of this committee, received later, showed that there were only 36 delegates who had offered their credentials, the remainder of the registration being absent through the confusion of the program.

The secretary made a verbal report, in which he stated that Columbus had been selected as the meeting place, partly because of its central location, but more particularly because the inducements held out in the invitation of Mayor Black had been the most acceptable of any offered. In preparation and notification for the event 1,100 pieces of mail matter had been sent out, and the entire list of speakers arranged for but one had failed in coming to the the meeting. Ample provision had also been made for the replacing of even this feature. The report was accepted. Supplementing this report, Chairman Lambert stated that an effort had been made to have the session either at Newark, N. J., or Worcester, Mass., but that neither city would guarantee a sufficient amount toward expenses.

The secretary then read several communications from Niagara Falls, two of which were from the mayor, Arthur C. Hastings, and superintendent of the Niagara Falls reservation, Thomas V. Welch, arguing the claims and advantages of that city as the next meeting place, while the other was from the city clerk, S. F. Arkisst, requesting that notice be given the convention and any interested person that bids were wanted on the electric lighting of the city for the coming year.

A committee of two, Alderman Petry, of New Haven, and W. H. Swindell, of Baltimore, Md., was named to confer with the committee on arrangements of the mayors' conference to prevent, if possible, by a rearrangement of program, any further conflict with that meeting. Mayor Black came in at this point, and after being introduced with a hearty reception, held a conference with the committee, which resulted in their deciding that the best thing that could be done under the conditions was to follow as closely as possible in their sessions those of the Mayors' Convention, the meetings to be convened in every instance immediately following the adjournment of the municipal conference. Their report to this effect was adopted.

The chairman then appointed a committee on by-laws as follows: Alderman Benton, Alderman Meade and D. Hunter, Jr. This committee held a session immediately after the adjournment of the meeting. The adjournment was made until

the conclusion of the Mayors' Convention session on the following day.

SECOND DAY'S SESSION.

It was 4:30 p. m. before President Lambert called the meeting to order, the delegates having lingered to watch the fire and police exhibition drill.

In his preliminary remarks President Lambert reported upon the progress of the association during the past year, showing a very pleasing increase of interest and support, concluding with a series of recommendations as follows:

That Messrs. B. F. Gilkison, E. D. Brown and H. J. Gordon, of New York, with A. R. Foote, of Washington, D. C., be made members of the association without dues. That the official organ of the association be City Government. That the convention in 1898 award a gold medal of honor for the best invention toward perfecting street lighting conveniences offered within the coming year. That a bureau of information be established by the association, and further, that the association petition Congress to secure statistics from cities abroad with regard to cost of street lighting, and furnish copies of such statistics to the association.

A paper was then read by Charles F. Hopewell, superintendent of wires and lamps, Cambridge, Mass., on "Electric Light Wiring." Mr. Hopewell dealt in detail with every phase and condition of street wiring, offering much valuable information as to the best material, processes and systems of equipment.

Mr. D. Hunter, Jr., superintendent of lighting, of Allegheny, Pa., followed with a paper upon the "Chaotic Conditions of Our Street Lighting Systems as to Cost, etc."[1]

Following Mr. Hunter came Mr. F. E. Barker, of Boston, Gas and Electric Light Commissioner of the State of Massachusetts, who was opposed to the idea of municipal control of electric lighting plants. Mr. Barker made his arguments especially with reference to Massachusetts, taking issue with Mr. Hunter principally upon the matter of producing electrical power. The point upon which special stress was laid was the question of the cost of fuel, which varies largely in Massachusetts from the generally uniform figures employed in Pennsylvania.

"The Power Development of Niagara Falls," by Hon. Arthur C. Hopkins, of Niagara Falls, N. Y., detailed at length the electric operations at that point. The capabilities of the plant already established were outlined, while the great possibilities of the future were touched upon. Points of pertinent interest were brought out with regard to cost of production, loss of power in transmission, etc.

Secretary Hopkins was heartily in favor of keeping the association strictly upon the lines that had been observed throughout their existence. He deprecated the lack of interest and attendance on the part of delegates in the city, but did not believe for all this that the association was losing force. The membership was largely in the East and the long distance had doubtless cut down the support. If absorbed by any other larger organization the association would necessarily lose its identity to no very small extent. There was no reason to permit the ardor of the membership to die out. It should not be permitted to suspend in favor of any organization. The outlook was never so favorable to fulfilling every hope of the originators. The discussion that followed was precipitated by a rumor that the mayors' organization would ask the street lighters to join issues with them under one name and organization.

In conclusion of the session the report of the committee on by-laws was received and ordered held until 8:30 of the next day, when its consideration would come up as a special order of business.

THIRD DAY.

The closing session was held in parlor A of the Chittenden. In opening the session the report of the committee on by-laws was offered by Chairman Burton of that body. In view of the fact of so small a representation of delegates it was moved that the report be tabled until the next annual session that their adoption should come only after consideration by the association as a whole. The motion was carried by a unanimous vote. The election of officers which followed resulted as follows: President, D. Hunter, Jr., of Allegheny City, Pa.; secretary, Charles Burton, of New Haven, Conn.; treasurer, C. E. Thompson, of Binghamton, N. Y.; official stenographer and assistant secretary, C. F. Roberts, of New Haven, Conn.

On motion the president was empowered to appoint five vice-presidents at his pleasure to represent as many sections of the country covered on the membership list of the association. These officials will be expected to work together with the other officers to the best interests of the association. The president was then ordered to appoint a committee of three upon transportation for the next convention. The resolution placing the annual dues at $5 was defeated, the amount being placed finally at $3.

[1] See page 331.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

The seventh annual meeting of the American Electro-Therapeutic Association was held in the Academy of Medicine, Harrisburg, Pa., September 21—23. There was present a considerable number of the active members of the association, although not so many as when the meetings have been held in the larger cities. The meeting was called to order on Tuesday at ten o'clock by the President William Thomas Bishop, M. D., of Harrisburg, Pa.

In the absence of Governor Hastings, of Pennsylvania, the address of welcome was delivered by Mayor John D. Patterson, of Harrisburg. Afterwards Dr. Robert Newman, of New York City, was introduced by Dr. J. Z. Gerhard, Chairman of the Committee of Arrangements, who responded to the address of welcome.

After the routine business the scientific session was opened by reports of committees on Standard Apparatus for Electrotherapeutic Work. In the absence of the chairman, Mr. A. E. Kennelly, of the Committee on Induction Coils and Alternators, no report was presented. Dr. Margaret A. Cleaves, of New York, presented the report of the Committee on Meters; Dr. C. R. Dickson, of Toronto, Canada, on Electrodes; and in the absence of the chairman, Mr. J. J. Carty, of New York City, of the Committee on Electric Light Apparatus for Diagnosis and Therapy and the Röntgen X-rays, the report was presented by F. Schavoir, of Stamford, Conn. In the absence of Dr. W. J. Morton, New York City, chairman of the Committee on Static Machines and Condensers, and of Dr. W. J. Herdman, Ann Arbor, Mich., chairman of the Committee on Constant Current Generators and Controllers, no reports for those committees were presented.

The following papers were read during the sessions:

"Electricity as an Aid in the Treatment of Goitre," Dr. Caleb Brown, Sac City, Iowa. An interesting paper on the "Electric Treatment in Gout and Uric Acid Diathesis," by Dr. Robert Newman, of New York, showing the great value of electricity and especially of the Franklinic current in these conditions. On "The Manifestations of Uric Acid and Its Treatment Electrically and Otherwise," by Dr. J. Griffith Davis, of New York. On "Chorea," by Dr. Francis B. Bishop, of Washington, D. C. On "Sources of Atmospheric Electricity," by Dr. R. J. Nunn, Savannah, Ga. This paper gave rise to interesting remarks by Prof. Dolbear and others. A paper on "X-Ray Work," by Dr. Eugene R. Corson, of Savannah, Ga. On a "New Electrode for the Use With Static Machine," by Dr. Lucy Hall-Brown, of Brooklyn. By Dr. George E. Bill, of Harrisburg, on "Some Considerations Relative to the Therapeutic Application of the Current." On "Heart Failure," by Dr. Eli H. Coover, of Harrisburg. On "The Expenditure of Electrical Energy," by Dr. Margaret A. Cleaves, of New York.

The "Molecular Effects of Electricity" were interestingly considered by Prof. A. E. Dolbear. This was supplemented by a paper read by title in the absence of the writer, Dr. W. J. Herdman, of Ann Arbor, Mich., on the "Influence of Magnetic Fields on Nutrition," giving in detail a series of experiments carried on during the past year or more showing the nutritive gain of dogs kept in magnetic fields, other dogs being kept for the purposes of control. These experiments tend to disprove the lack of evidence of physiologic effect from magnetic fields.

A paper was read by E. Jewell, E. E., of Chicago, on a "Current Regulating Apparatus." By Dr. G. B. Massey, of Philadelphia, on the "Electromercuric Treatment of Cancer," and three papers were presented by Dr. J. Bergonie, Bordeaux, France, one of the Honorary Fellows of the association, viz., on "A New Electrode, Preventing the Diffusion of the Current"; "Palliative Electric Treatment of Tic Douloureux of the Face"; "The Action of the Röntgen Rays on the Vitality and Virulence of Koch's Bacilli in Cultures."

The following officers were elected for the coming year: Dr. C. R. Dickson, of Toronto, Canada, president; Drs. Schavoir, of Stamford, Conn., and Brown, of Sac City, Iowa, vice-presidents; Dr. John Gerin, of Auburn, N. Y., secretary; Dr. R. J. Nunn, Savannah, Ga., treasurer. Buffalo was selected as the place of meeting for the next year, and the time the second Tuesday in September.

Members of the association were received by the Pennsylvania State Lunatic Hospital at their pleasure during the ses-

sion and also on Wednesday at the Executive Chambers by Governor Hastings, of Pennsylvania.

A considerable number of papers were read by title in the absence of the writers. A number of new members were elected.

The General Electric Company exhibited their X-ray apparatus; the Fessenden X-ray Company also made an exhibit.

THE NATIONAL ELECTRICAL CODE ADOPTED BY THE A. I. E. E.

The meeting of the Institute on Sept. 29 was called for the purpose of acting on the adoption of the "National Electrical Code," which has been adopted by the Factory Mutual Fire Insurance Companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light Association, and the Underwriters' National Electric Association.

Mr. W. J. Hammer on behalf of the Institute Committee briefly set forth the history of the new rules and advocated their adoption by the Institute. The formal motion to that effect by Dr. A. E. Kennelly led to a prolonged discussion.

Mr. C. O. Mailloux pointed out that the National Code was not entirely in conformity with the new rules of the New York Fire Department, which latter he considered in many respects superior to the Code and better adapted to the work now called for in the metropolis. Other members spoke in the same vein, among them Mr. Joseph Sachs and Mr. S. Dana Greene. The latter gentleman pointed out that the Code did not take full cognizance of the latest work in long distance power transmission, in which practice had dictated methods forbidden by the new Code.

Mr. E. N. Goddard in defense of the Code stated that the rules it embodied did not in every case meet with the unanimous accord of all of those by whom they were framed and he instanced examples. They did, however, represent the opinions of the majority of delegates who formulated them. The principal object aimed at was uniformity throughout the country. Besides, the Code itself contained clauses explicitly stating that its recommendations could, under certain conditions, be subservient to the rules of local inspecting authorities. Experience would soon show what changes would be desirable and in fact a meeting would take place in December for the special purpose of making such revisions as would seem desirable in the light of past experience.

After further discussion by Mr. A. H. Henderson, Mr. Moscrop, and others the Code was adopted by the Institute, with an amendment to the resolution, proposed by Mr. S. Dana Greene, that a committee be appointed to submit such changes as may be desirable at the next meeting of the Code Conference in December.

CHICAGO ELECTRICAL ASSOCIATION.

This association has just issued its fall and winter program, the following being the list of papers thus far announced:

October 1. "Economy in Electric Car Control," by James R. Cravath. October 15. "Evolution of the Isolated Electric Plant," by Harold Almert. November 5. "The Safe Current Capacity of Electrical Conductors," by C. H. Sewall. November 19. "Daily Mathematical Conveniences," by S. G. McMeen. December 3. "Heavy Electric Traction," by Cloyd Marshall. December 17. "Electricity in Ship Building," by C. C. Mattison. January 7. "Electrical Shop Transmission," by H. G. Dimmick. January 21. "The Art of Constructing Telephone Apparatus," by Henry P. Clausen.

The secretary of the association is Mr. J. R. Cravath, 825 Monadnock Building, Chicago.

LETTERS TO THE EDITOR

THE LIFE OF WEATHERPROOF WIRE.

In answer to O. B. in your issue of September 23 I would say that in the winter of 1888-1889 we put up some fifteen miles of the best triple braid weatherproof wire. During the past year most of the outer braid has sloughed off and we expect the remaining two braids to go during the next year or two. Of course, wound layers (not braid) would not last so long.

D. L. DAVIS,
Superintendent Salem (O.) Electric L. & P. Co.

WHAT IS THE BEST MAGNET STEEL?

Will some one of your readers inform me what is the best make of steel for permanent magnets used in magneto generators and telephone receivers made in this country and in foreign countries.

J. G. R.

OBITUARY

THOMAS W. FOWLER.

Thomas W. Fowler died on Sept. 30, in the seventy-seventh year of his age, in Brooklyn. He was for many years connected with the car shops of the Brooklyn City Railroad, and later had charge of those of the Lewis & Fowler Car Company. He retired from active business seven years ago. A widow and three children survive him. The latter are Dr. George R. Fowler, Mrs. A. E. Owers, and Mrs. J. E. Wood, all of Brooklyn. Mr. Fowler was born at Hempstead, L. I.

MR. G. A. COULTER, formerly superintendent of the fire and police alarm system of Omaha, Neb., and more recently in the construction department of the Nebraska Telephone Company, died on September 24 of injuries received from a fall while supervising some work. He leaves a widow.

REPORTS OF COMPANIES

METROPOLITAN TRACTION CO., NEW YORK.

The report of the Metropolitan Street Railway Company, of New York City, for the year ending June 30 last, shows: Gross earnings from operation, $8,888,804; operating expenses, $4,810,235; net earnings from operation, $4,078,569; other income, $547,529; gross income from all sources, $4,626,098; fixed charges, $3,186,975; net income from all sources, $1,439,122; 4 per cent. dividend on $30,000,000 stock, $1,200,000; total surplus, $1,332,488; cash on hand, $295,013; number of passengers carried, including transfers, 234,705,704; transfers issued, 56,929,611.

The net earnings of the company during the year were increased by $98,690, as the result of interest on investments owned by the Metropolitan Street Railway Company, but formerly paid into the treasury of the Metropolitan Traction Company, and which now goes to the former company. The net income of the year ended June 30, 1896, was $1,466,847.

THE STOCK MARKET

ALL CONDITIONS IMPROVING.

The railroads of the country continue to give marked signs of improvement, the group reporting last week showing a gain in net of nearly 15 per cent, some of the increases in gross being enormous, especially on the large systems.

Bank clearings for the week show a gain of 36 per cent. over the last week of September, 1896, and the clearings for the month are the largest since January, 1893. Increased activity is manifest in iron, steel, wool, hides, and coke is advancing in price.

Speculation has undergone a reaction from the recent pronounced bull fever, but is brisk and cheerful again. 43,674 shares of Western Union sold during last week, closing at 90¾, and this week the price has reached 91½. Of General Electric, 21,349 shares were sold, up to 37¼. In Boston, American Bell Telephone settled back to 262½ on sales of about 1,600 shares.

Copper is unchanged at 11.25 cents.

Steel rail is in remarkably brisk demand at from $20 to $22.50.

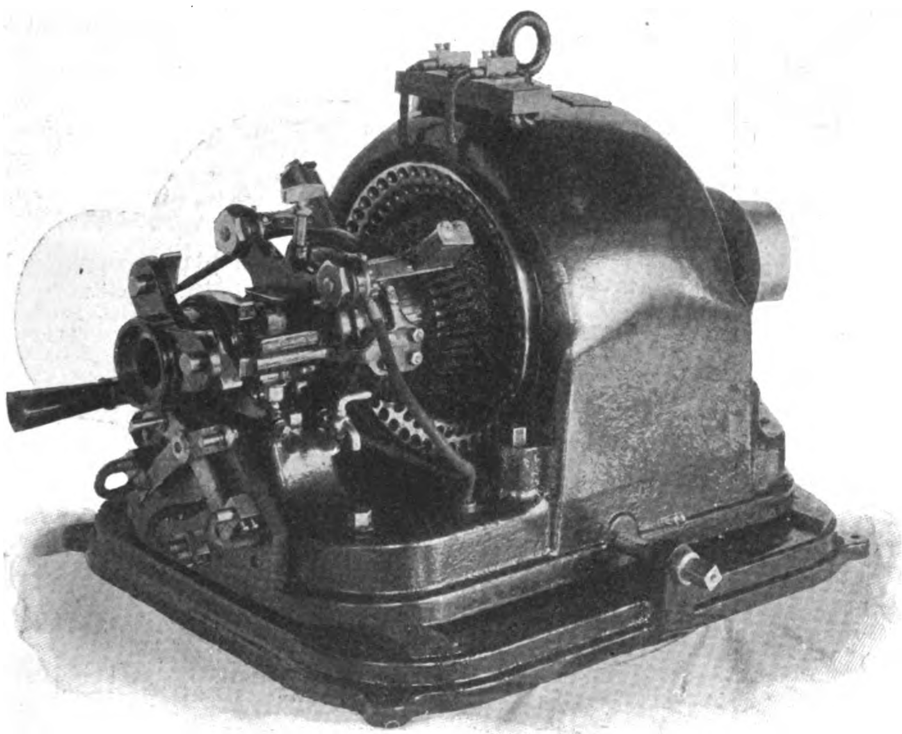
TRADE NOTES & NOVELTIES

THE WAGNER SELF-STARTING SINGLE-PHASE ALTERNATING MOTOR.

FOR several months past the Wagner Electric Manufacturing Company, of St. Louis, have had under working test a self-starting, single-phase alternating induction motor, designed to be put in the same circuit with incandescent lamps. The company's tests having proved eminently satisfactory, the new motor has recently been brought out, with the belief based on actual experience, that it offers the solution of the problem of enabling single-phase alternating stations to obtain a good working day load.

The new motor, which is illustrated in the accompanying engraving, imposes no limitations of frequency or character of circuit. Special transformers are not necessary, nor are auxiliary starting devices required. A simple two-wire connection to the main secondary circuit of any standard transformer for ordinary lighting service constitutes the wiring entire.

The principle of the motor is extremely simple. As in all motors built for alternating systems, there is a primary and a secondary element, these bearing the same relation to each other as the primary and secondary coils of a static transformer. The primary constitutes the stationary element corresponding to the field of a direct current motor. The secondary is the movable element, corresponding to the direct current armature. This secondary is constructed to operate in a double way. For starting, it is thrown in series with the primary by means of carbon brushes running on a commutator. With this connection, the operation of the motor is in every essential feature exactly that of a series direct current motor. On attaining the running speed the connections are simply changed, the commutator in the operation of changing, being completely short-circuited and the carbon brushes lifted off. The motor then runs as a non-synchronous, induction motor. The engraving shows the handle by means of which the current is applied to the motor.



WAGNER SELF-STARTING SINGLE PHASE ALTERNATING MOTOR.

The curves of tests of this machine are very interesting. The efficiency curve rises very rapidly on light loads and a high efficiency is maintained up to 50 per cent. overload. There is also but a very small drop in speed with increased loads, with a high power factor at all loads.

As regards torque, it is possible to pull up from rest double the rated load of the motor with a current only exceeding the load current by 50 per cent. Such a starting condition does not exist in practical work, but as illustrating the severity of the tests imposed on the motor in its process of development it may be said that this was a test applied. These motors are at present built in sizes from 1½ to 10 h. p., and for frequencies of 60 and 133 cycles.

THE PURITAN ALTERNATING ENCLOSED ARC LAMP.

THE accompanying illustration represents the arc lamp manufactured for alternating current circuits by the Puritan Electric Company. In this lamp the faults and failings of the old open arc have been remedied, and the difficulties encountered in the application of arc lamps to alternating current circuits are claimed to be completely surmounted.

The lamp is designed to burn on a secondary voltage anywhere between 90 and 120 volts, and taking 6 amperes of current the total wattage of the lamp will range between 400 and 450, of which all but 25 watts is actually consumed at the arc in producing light. The mechanism is simple and not easily deranged, and 100 hours life are obtained from two 7½-inch x ½-inch carbons, the upper and lower carbon being of the same length.

THE PURITAN ALTERNATING ENCLOSED ARC LAMP.

It is adapted for use for both inside and outside lighting and the humming and buzzing common to the old alternating arc has been entirely eliminated, making it unobjectionable in even the most confined quarters, while its short length makes it adaptable to the lowest ceilings. No special transformers or economy coils are necessary and the lamp is entirely self-contained and burns in multiple.

A PRESENT PHASE OF THE NEW PATENT LAW.

Owners of foreign patents on inventions not yet patented in the United States may be interested in the following statement, which was formulated by Mr. E. P. Thompson, Temple Court, New York, with the new statute as a basis, and forwarded to his foreign associates:

You should advise your clients to proceed immediately to apply for valid United States patents for valuable inventions

already patented in a country, foreign to the United States; for after December 31, 1897, only 7 months will be allowed after filing the application in said foreign country.

A copy of the new law will be sent on request by Mr. Thompson.

THE 2,000 K. W. THREE-PHASE GENERATOR FOR THE BROOKLYN EDISON CO.

THE great three-phase alternating current dynamo, intended for the new station of the Edison Electric Illuminating Company, of Brooklyn, N. Y., at Bay Ridge, has been shipped from the works of the General Electric Company, Schenectady, N. Y. To transport this exceptional generator to its destination not less than five flat freight cars were needed.

The generator is an alternating current three-phase machine, of the revolving field type, with forty poles and a normal output of 1,500 kilowatts when running at 75 revolutions. In use it will be driven directly by an engine giving its highest economy at a little over 1,500 kilowatts, or which can be operated to advantage, and will probably be operated at an

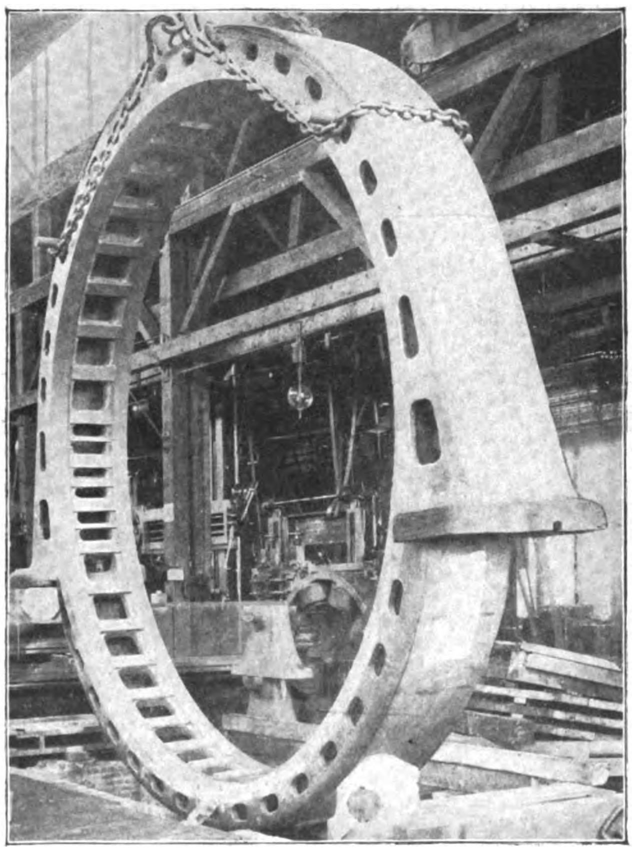


FIG. 1.—2000 K. W. THREE PHASE GENERATOR, BROOKLYN EDISON CO.

output of 2,000 kilowatts. The engine selected is a four-cylinder triple-expansion engine, built by the McIntosh & Seymour Company.

The dynamo is wound for an output of 2,000 kilowatts at 6,600 volts. The armature windings are mounted upon the stationary part of the machine, shown in Fig. 1. Those windings form one of the most interesting features of the construction of this class of machine, the method of coil construction and insulation being especially adapted to high voltage work.

The field structure is built upon a cast iron spider, with a steel ring bolted to the ends of the spokes. To this ring are bolted 40 field pole pieces, each built up of carefully annealed sheet-iron laminations. Each pole piece carries a coil made of heavy copper strip wound on edge. All these coils are connected in series, the direct current used for excitation being carried through them. This field structure will be mounted on the steel shaft, 27 inches in diameter, of the triple expansion engine. On the same shaft are the engine cranks and a heavy fly wheel, of such weight that the angular variation of speed within each revolution at full load cannot exceed one-quarter of 1 per cent.

The armature structure will be supported on rails instead of a masonry foundation. This allows the armature to be moved along the rails away from the field, giving easy access to both field coils and armature winding.

The size of this machine, and incidentally the range of the dynamo and motor work of the General Electric Company, may be gauged from the illustration, Fig. 1, which shows standing beside the armature frame a G. E. induction motor of ½ h. p. capacity. The dimensions of the generator are as follows:

Span of casting or lower half of armature frame, 25 feet.

Vertical outside diameter of armature frame, 31 feet 2 inches.

Length along shaft, 51 inches.

Weight of revolving field, 59,000 pounds.

Total weight, 163,000 pounds.

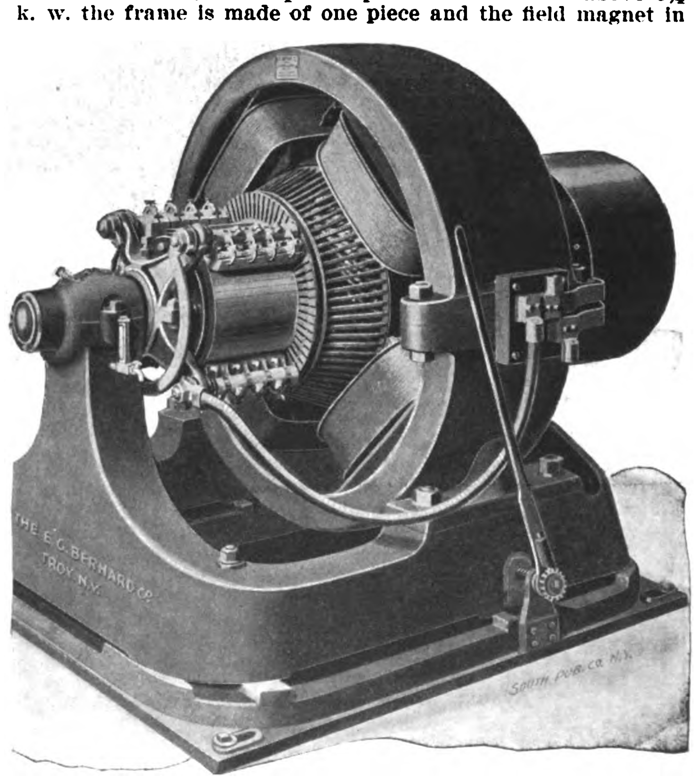
NEW E. G. BERNARD CO. DYNAMOS AND MOTORS.

THE accompanying illustration represents the new type of slow and medium speed, direct current multipolar dynamos and motors of the E. G. Bernard Co., of Troy, N. Y.

The main feature of the general design is the circular yoke, which has been adopted by all other leading manufacturers as the best form to use.

The aim has been to produce a sparkless, slow speed and highly efficient machine. Ample allowance has been made with copper, iron and steel, yet at the same time special care has been taken in the design to avoid all unnecessary weight.

The machines are of the multipolar type, and in construction are divided into two classes of the same general style. Up to and including 6¼ k. w. the frames and fields are solidly cast in one piece. For convenience in handling, the sizes above this are cast in separate pieces. In all sizes above 6¼ k. w. the frame is made of one piece and the field magnet in



THE BERNARD DYNAMO

two parts, so that the top can be lifted, thus permitting free access to the armature or the field coils.

The generators are absolutely automatic in regulation, and are over-compounded, so that they can be readily adjusted to suit any condition of service that may be encountered. All machines are wound and made exactly alike, so in case it is desired to run two or more in multiple, they will work perfectly together, without sparking, and with an even division of the load.

The magnet yokes are made of the best mild open hearth steel. The magnet cores in the larger sizes are laminated and made of the best electrical sheet iron, cast solidly into the magnet yoke. The faces of these cores are slotted and distribute the magnetism uniformly over the armature. The field coils are wound upon insulated spools. In the compound wound machines the shunt and series coils are separated by an insulated partition.

The armatures are of the iron-clad type, having copper conductors embedded below the surface in insulating tubes made up of mica and oil paper. In the larger sizes, copper bars are used, without any joints except at the commutator end. The armature cores are constructed from discs of special armature iron, which are very carefully annealed and thoroughly tested. These are built up on the armature spider in such a way as to give thorough insulation and ventilation through longitudinal openings, permitting air to pass freely from one end of the armature to the other. The ventilation of the armature is further increased by air ducts perpendicular to the axis of the core.

The brushes in the patented reaction brush holders adjust themselves to a bearing with minimum friction, and at the same time make almost perfect contact with the holder. The simplicity of the brush holder permits a brush to be easily replaced in 5 to 10 seconds, and while the machine is in operation.

The machines smaller than 75 k. w. are of the four pole type, which type has been found to give the best results in machines of this capacity.

The bearings are made of the finest quality of chemical bronze, of the self-oiling, self-aligning, ball-and-socket type.

The belted machines up to 60 k. w. are fitted with adjustable base rails. Those of 60 k. w. and larger are fitted with an adjustable sub-base and with removable ratchet for moving the machine backward and forward.

The company guarantee that should any part prove defective from workmanship or material or should it not be as represented in their contract, they will replace the same at any time within one year from date of sale.

AMERICAN ELECTRIC APPARATUS IN JAPAN.

WE are constantly being advised of orders having been placed with American manufacturers for electrical machinery for export, and, judging from the frequency of these orders of late from Japan, it would seem that that country is just now fully awake to the advantages to be derived from the use of electrical machinery for lighting and power transmission. Mention was made, a few weeks since in our columns, of a large electric power transmission system to be installed in a large car-building works at Nagoya, in Japan, by the C & C Electric Company, of New York, which will be the first installation of this kind in Asia and which, we are advised, is to be completed during this month.

We also learn that the Hankaku Railway Company, of Osaka, Japan, has just decided to equip its shops with an electric power transmission system and will employ C & C apparatus also. The order for motors which has just been placed includes some ten machines, aggregating some 80 or 90 horse power. The motors will be of the C & C enclosed ironclad type, except a few of small size, which will be of the C & C "2P," or bipolar type. For driving these there will be employed a C & C 75 k. w. generator of their new "M. P." or multipolar type. No efforts are to be spared to make this a model installation and it is intended to shortly greatly increase the capacity of the plant.

Mr. Lamar Lyndon, the manager of the C & C Electric Company's office in Kobe, Japan, has advised his company by last mail that he expects, early this month, to forward to New York a contract for electric power transmission equipment "which will be a record-breaker in its magnitude," and which is to be employed in one of the largest manufacturing institutions in Japan.

THE POPE MOTOR CARRIAGES.

IT is one thing to own a motor carriage and another to know how to take care of it. To supply the latter valuable information the Pope Manufacturing Company, Motor Carriage Department, Hartford, Conn., have just issued an exceedingly handy and complete little pamphlet containing full directions for taking care of their Mark III Columbia motor carriages. Here we find first a complete technical description of the carriage, in plain language, followed by a minute series of instructions for its operation, including charging of the batteries, starting, controlling, steering, braking, etc. The care of the brushes, tires, oiling, etc., is also fully set forth. We note, in addition, brief directions for installing city circuits in stables or coach houses.

A novel and exceedingly valuable feature of the little book is a list of the electric light stations in the principal cities and towns of the States of Connecticut, Massachusetts, New York, New Jersey, Pennsylvania and Rhode Island. The list is accompanied by directions as to what current to ask for and whether it is obtainable at the electric light station or from private plants.

The little work is exceedingly well done and will prove of great value to owners of motor carriages.

GROWTH OF THE WARD LEONARD ELECTRIC CO.

THE recent rapid growth of the business of the Ward Leonard Electric Company has made it necessary for it to secure much more extensive manufacturing facilities. Consequently the company recently purchased a large, four-story, stone factory, located on the Bronx river, at Bronxville, N. Y., together with about an acre of ground and an additional separate stone building.

The Ward Leonard Electric Company will have both the New York Central and the New York, New Haven & Hartford Railways at their disposal for shipments. Bronxville being but two miles north of New York City, and having over 80 trains per day connecting it with the Grand Central Station at 42nd street, the factory will be extremely accessible to the New York trade.

The Ward Leonard Electric Company has equipped the factory with a complete electric power transmission system, direct connected shaft motors being used. Generators of 10 volts, 125 volts, 250 volts and 500 volts continuous current, and 1,000 volts alternating current have been installed. The steam plant is of the most efficient type throughout.

The company has just gotten into its new factory and is running night and day. It will have plenty of room to expand in its new quarters, but on account of the demand for its new types of automatic circuit breakers and rheostats expects that the surplus space will soon be actively employed.

SOME RECENT CHLORIDE STORAGE BATTERY INSTALLATIONS.

The Electric Storage Battery Company has closed a contract with the Edison Electric Illuminating Company, of Boston, for a battery of chloride accumulators. This will make the fifth battery in the service of the Boston Edison Company.

Contracts have also been recently closed for central station batteries with the Cleveland Electric Illuminating Company and the Richmond (Va.) Railway and Electric Company, and for batteries for regulation on trolley roads with the Central Railway Company, of Baltimore, and the Potomac Electric Power Company, of Washington. The Potomac Company have been operating a battery of chloride accumulators for about a year. A battery is also being installed on the lines of the Barre & Montpelier Electric Railway, Montpelier, Vt.

Chloride accumulators are being installed in the Reading Terminal Station in Philadelphia to carry the peak of the load, and to furnish current for the lamps burned during the early hours of the morning.

A battery is being installed in the new library building of Princeton University. This battery is to be charged by the town plant between dusk and midnight, and during other hours will furnish the current required for the lamps and for operating three ventilating motors, two elevators and one book lift. The government has recently contracted for a battery for lighting work at David's Island, and has also ordered something over 1,000 cells to be distributed at some 20 odd points for coast defense work.

Chloride accumulators have been installed in the residence of Mr. S. S. Childs, Baskingridge, N. J., where they are being operated in connection with a gas engine-dynamo plant.

D. S. Brown & Co., New York, are installing chloride accumulators for night lighting in their new factory.

AMERICAN RAILWAY APPARATUS FOR IRELAND AND SPAIN.

The British Thomson-Houston Company, of London, through its representative, Mr. A. K. Baylor, has just closed an important electric railway contract with the companies operating the tramway systems of Dublin, Ireland, and Barcelona and Madrid, Spain. The contract for Dublin includes all steam, as well as the electric generating and motor equipment, and comprises 6 Allis horizontal engines of 500 h. p. each, with Babcock & Wilcox boiler capacity necessary; 6 500 kilowatt multipolar General Electric generators for direct connection to the engines and complete switchboard and station equipment. The car equipment will consist of 150 complete motor and series parallel controller equipments, the motors to be mounted on Peckham trucks. This contract follows closely that made for the equipment of the Clontarf line of the Dublin tramway system, which will be opened within the next week or two. The apparatus for this was also supplied by the British Thomson-Houston Company.

The contract signed for the Barcelona and Madrid roads cover 5 400 kilowatt multipolar General Electric generators and three of 75 kilowatts each, all to be directly connected to the engine shaft. While the three latter will be lighting generators, they will also be wound for 500 volts. This contract also includes full station equipment.

BERLIN ROOFS.

The roof of the new Spence Library of the Union Theological Seminary at Richmond, Va., will be of fireproof construction. The trusses will be steel, and the covering slate attached directly to metal supports. One end of the building is round, making a conical shape roof, and at various points of the roof slope are placed dormers and skylights. The peculiarity of the construction makes the iron work very intricate in order to get the pleasing architectural appearance desired. The contract for furnishing and erecting the steel work for the roof has been given to the Berlin Iron Bridge Company, of East Berlin, Conn.

ORIENT LAMPS FOR UNCLE SAM.

We are informed that one of the largest orders ever given by the United States government for incandescent lamps has just been booked by the Orient Electrical Company, of Youngstown, O. This was probably a case of the best all around—best in price and quality. The fact that the order was received in the face of strong competition makes it specially gratifying to the Orient Company.

ADVERTISERS' HINTS

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, Ill., say the Upton Midget enclosed arc lamp is one of the most satisfactory specialties they have ever handled.

H. B. COHO & CO., St. Paul Building, New York, advertise complete electrical equipments for isolated plants especially.

THE PRENTISS CLOCK IMPROVEMENT COMPANY, New York City, will send a descriptive catalogue of their clocks and system of electric regulation and movements.

EDWARDS & CO., 144th street and 4th avenue, New York City, call attention to their loud ringing bells. These will be found extremely useful in schools, factories, etc.

AMERICAN ENGINE COMPANY, Bound Brook, N. J., illustrate a direct connected unit. It may be remembered that both their engines and dynamos have the advantage of being built in the same shops.

THE WALKER COMPANY, Cleveland, O., draw notice to the method of suspending their street railway motors by which both ends of the motor are flexibly supported on the truck.

THE ANCHOR ELECTRIC COMPANY, 71 Federal street, Boston, Mass., say "the Anchor push button switch leads them all." This switch was fully described in our last issue.

THE DIAMOND STATE FIBRE COMPANY, Elsmere, Del., offer hard fibre in sheets at 10 cents per pound. They also supply rods, tubes and special shapes to order.

THE STRANGE FORGED DRILL AND TOOL COMPANY, New Bedford, Mass., state that they are the makers of the only forged twist drill in the world. They also make chucks, rose reamers and machinists' tools.

THE WHEELER REFLECTOR COMPANY, 19 Washington street, Boston, Mass., say that street illumination may be quadrupled by means of their reflectors and propound the query, "Why light the heavens?"

WESTERN NOTES

THE MANHATTAN GENERAL CONSTRUCTION COMPANY inform us that Mr. J. H. Cooke, of Chicago, no longer represents them as manager of their Western office, and that the same has been placed in the hands of Mr. George Walker Conover, 1511 Monadnock Building, Chicago, where all communications for this company in relation to Chicago business should be sent. Mr. Conover has had a long and active experience in the handling of arc lamps, and the company feel that the new manager of their Chicago office will add still more to the success of the Manhattan lamp in the West.

THE ELECTRIC APPLIANCE COMPANY have just issued a new circular on the Midget Upton long burning arc lamp, giving a complete description of the lamp in the various styles and types, together with illustrations of complete lamps and the working mechanism.

FOREST CITY, ARK.—St. Francis Electric Light Company, C. C. White, secretary, have loaded up their generator of 600 lights capacity and will soon have to put in another as large, or larger. The company also contemplate putting in ice machinery.

J. B. EHRSAM & SONS, of Enterprise, Kan., have purchased a part of the material formerly used by the Abilene Electric Light Company and will use it in the construction of a plant for their shops. A dynamo will furnish light at night in the shops and also for the Hoffman Mills. A motor will also be put in to run the Hoffman elevator on the north side of the river, and other motors will probably be installed.

NEW YORK NOTES.

C. B. STERLING & CO. have opened an office at 120 Liberty street, New York, and will act as general electrical manufacturers' agents. They are open for a few good specialties and would be glad to correspond with companies requiring active representatives in the Metropolitan district.

JOHNSON & MORTON, 26-28 Catharine street, Utica, N. Y., are doing a lively business in electrical repair work, including rewinding of armature and field coils and reinsulating and refilling commutators. They make a specialty of "rush" orders and receive telephone calls at any hour of the day or night. Their equipment embodies the latest machinery; they employ the most skilled workmen and they make their prices correct.

THE C. J. FIELD COMPANY have removed their offices to room 1509 Johnston Building, 30 Broad street, New York.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

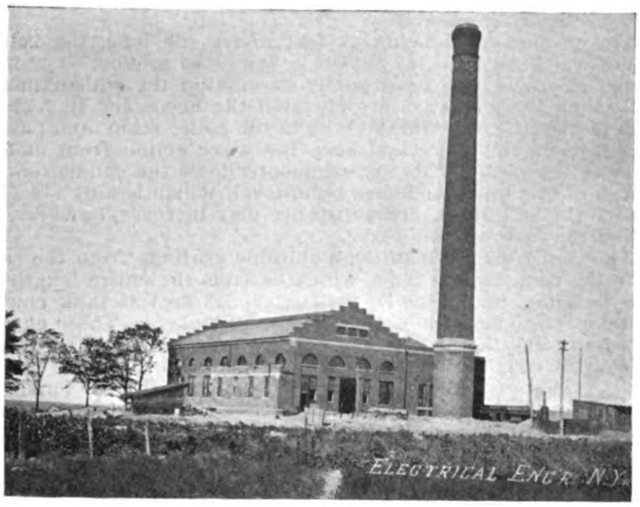
VOL. XXIV. OCTOBER 14, 1897. No. 493.

ELECTRIC TRANSPORTATION

A HIGH SPEED ROAD.—THE LORAIN AND CLEVELAND ELECTRIC RAILWAY.

BY E. P. ROBERTS.

THE first of October will see the opening of one of the most completely equipped and thoroughly constructed electric lines in the country. Of the many lines converging at Cleveland from the suburbs, it will stand alone as an example of the most modern practice.



POWER HOUSE, LORAIN & CLEVELAND R. R.

Starting from the Public Square, the cars will run over existing city limits 8½ miles to Rocky River, through business and residence districts, part of the distance being through the hamlet of Lakewood. After crossing the beautiful gorge of Rocky River the road leaves the highway, and from this point the company owns its own right of way. This extends practically parallel to the shore line of the lake, a distance of 18½ miles, to Lorain, a growing city of about 12,000 inhabitants.

DOUBLE-TRACK GIRDER SPAN OVER L. & C. R. R. TRACKS.

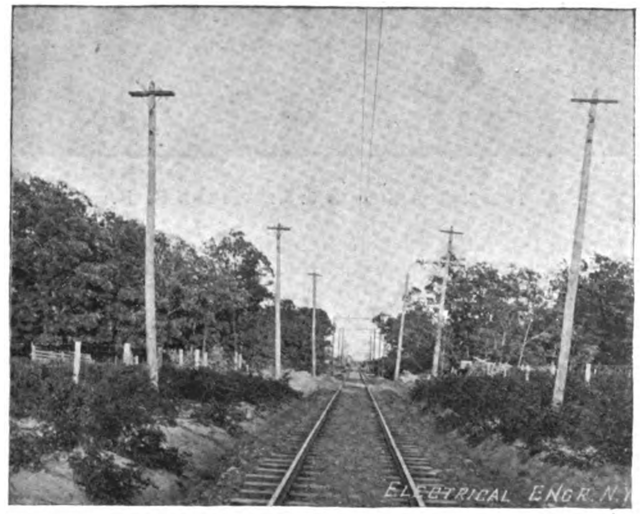
It is to open up a region of country that has, strangely, never before been accessible except after a tedious journey, and will give miles of lake front advantages for summer homes and suburban resorts.

THE ROADBED.

The company has spared no pains to make the roadbed equal to the best steam road practice. The curves are few and the sharpest one on the main line is only a 4 deg. curve, equivalent to a radius of 1,430 feet. The grades are hardly worth mentioning, being for the most part only about 20 feet to the mile, and the steepest one, if it may be so designated, 40 feet to the mile. Embankments are made 14 feet wide and cuts 18 feet, slopes being 1½ to 1. Gravel ballast is used. The ties are 6x8 in. x 8 feet, 2,640 to the mile.

The rails are in 60-foot lengths; T rails, 70 pounds per yard, American Society of Civil Engineers standard pattern. They were rolled at the Edgar Thomson Steel Works. They are laid with suspended joints, using heavy angle bars. The nuts are secured with the National nut lock, and are inside the rails, instead of outside, as in current practice, to facilitate inspection by the track walker.

The road is single track, except at the Rocky River end, where, through the village, the curves are sharper and closer together, and to secure safety and speed there is about one mile of double track. There are three passing sidings, each 1,500 feet long, besides a long switch, at Avon Beach Park, where the spur to the power house is taken off, and a Y and switch at the Lorain terminal.



TRACK AND LINE CONSTRUCTION, LORAIN & CLEVELAND R. R.

The road passes under the Nickel Plate right of way, which at this point is carried over on a double track plate girder, having a span of 55 feet, shown in one of the accompanying engravings.

There are four trestles on the line, the longest being 576 feet in length, and 40 feet high. Smaller openings are spanned with I beams. Masonry foundations are used under all these structures.

The right of way for the entire distance is from 40 to 60 feet wide, and is enclosed by wire fence made by the Page Woven Wire Fencing Company, of Adrian, Mich. All special track work was done by the Cleveland Frog and Crossing Company.

AVON BEACH PARK STATION AND CAR HOUSE, LORAIN & CLEVELAND R. R.

THE LINE CONSTRUCTION.

The line construction is also very substantial. Overhead frogs are avoided by the use of the double trolley system. The trolley wire is Washburn & Moen's figure 8 wire, equivalent to No. 000. The hangers and other overhead material,

other than wire, were furnished by the Ohio Brass Company. Thirty-five foot poles are used in a double line for cross suspension. The feeders are 300,000 c. m. solid—there being three going each way from the power house at present. Garton lightning arresters are used on the lines.

THE ROLLING STOCK.

The cars are J. G. Brill & Co.'s standard 41 feet double truck. They are equipped with 4 50 h. p. General Electric motors and controllers and these are expected to give a very rapid acceleration in starting. Electric brakes are also provided.

The run to Rock River is made in 40 minutes and from then to Lorain, 18½ miles, in 35 to 40 minutes, or about 30 miles per hour, running time, which, with frequent stops, requires a speed to be attained of 45 to 50 miles per hour.

TRESTLE ON LORAIN & CLEVELAND R. R.

THE OFFICES AND CAR BARNS.

The superintendent's office and operating offices are located in a handsome brick structure, 200 feet by 65 feet, at Avon Beach Park. In the same building are the car barns, repair shops and waiting rooms. This point of the road is destined to be the operating center, as north of the offices and car barns the company owns 20 acres fronting on the lake, which will be converted into a park, and in which is located the power house, from which all the power used on the line is taken. This park is 12¼ miles from Rocky River, and will undoubtedly prove an attractive resort.

The water supply for the entire settlement is obtained through a 24-inch intake pipe, which, because of shallow water, had to be extended 1,200 feet into the lake to avoid trouble from anchor ice. This pipe supplies water to a large "cold well" just outside the power house on the shore, and the supply for all uses is obtained from this well and pumped into a 50,000-gallon tank through an 8-inch pipe. From this tank 6-inch mains supply the car house and the settlement around the park.

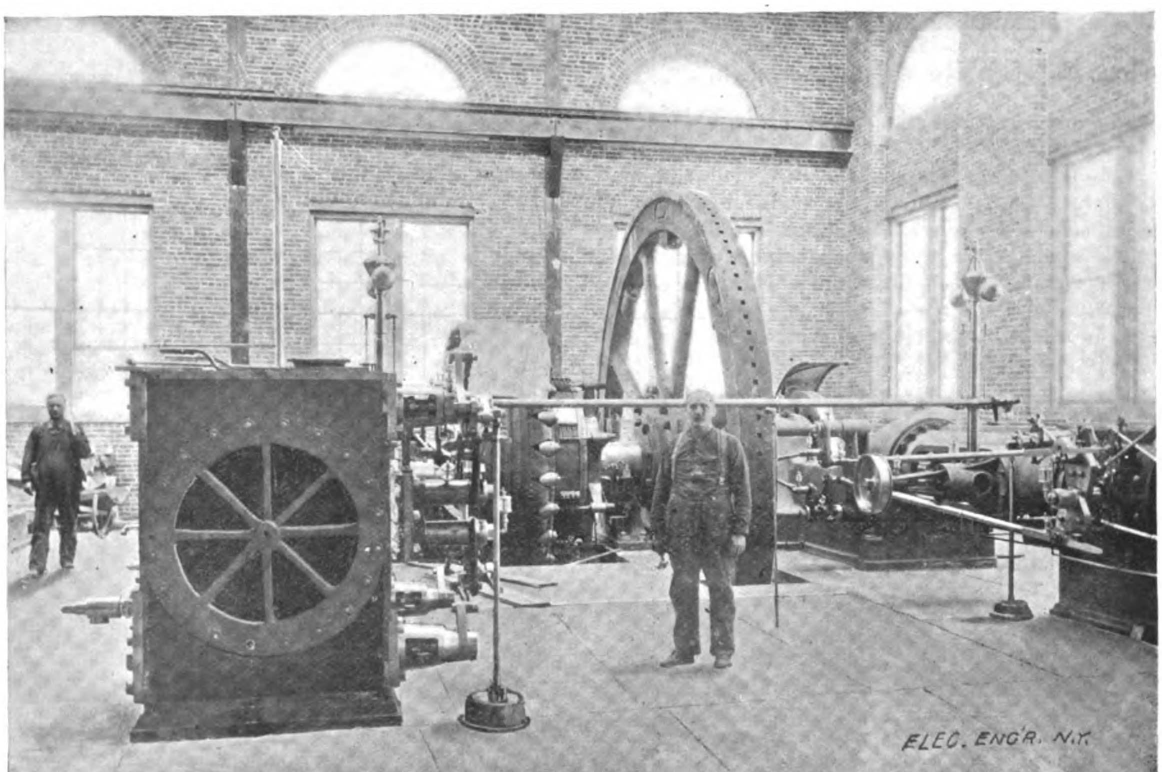
The plans of the company have been to allow for future extension in every way, and this is especially noticeable in the case of the power house.

THE POWER HOUSE.

As the car service is intended for high speed and rapid acceleration, the fluctuations of load are very great and momentarily even 100 per cent. in excess of the rated capacity of the generators. The power house was made large enough to include space for an engine and generator of twice the capacity of those now installed and the stack was made to accommodate even a still further addition if it should ever be necessary. The engines, steam piping, and generators now in place, are designed to stand a steady 50 per cent. overload, or even 100 per cent. momentarily.

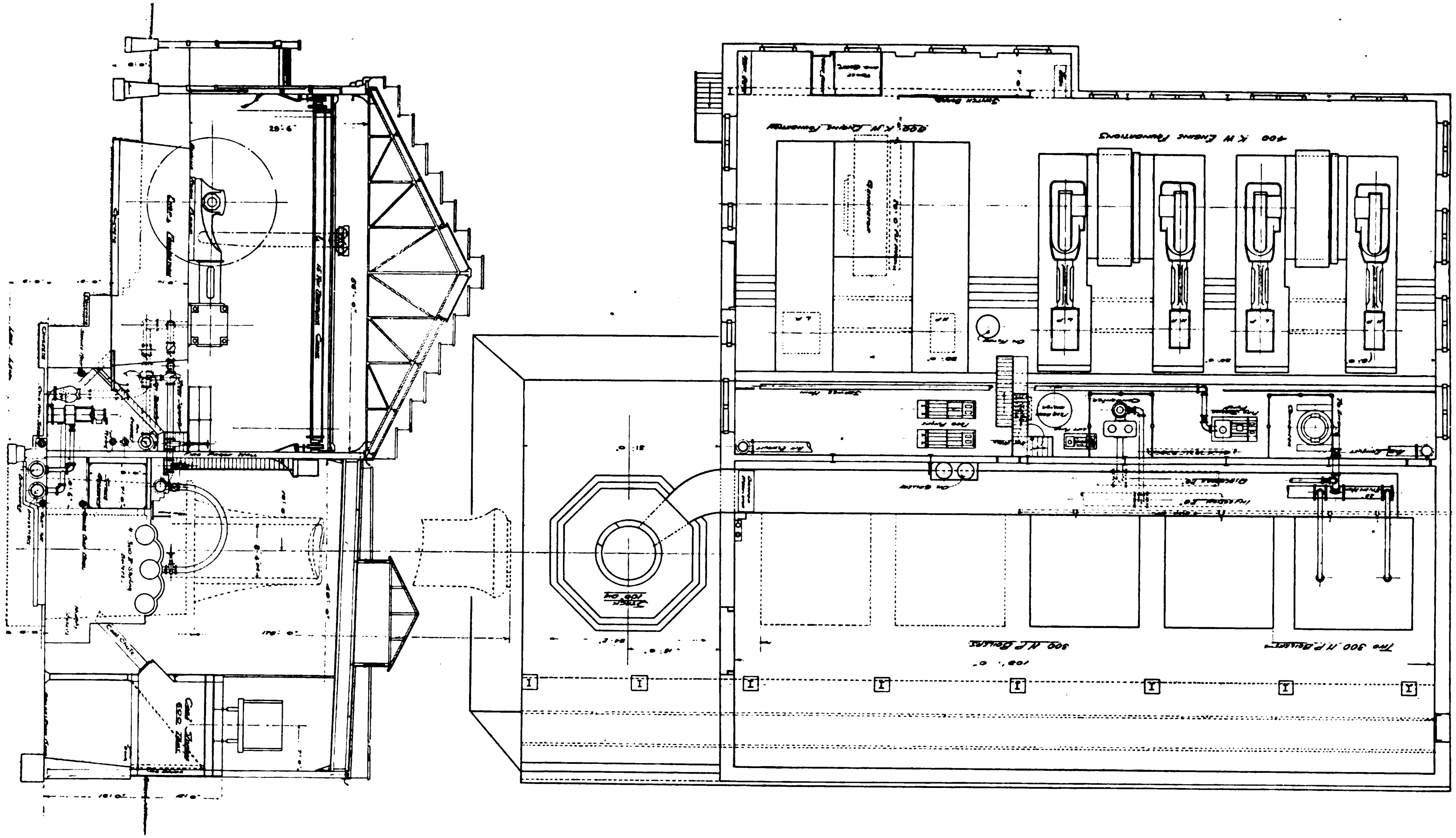
The ground level being 22 feet above the lake, the boiler room was excavated, as shown in the cross section. The material obtained was used partly in making the embankment, on which the coal cars are elevated the necessary 12 feet to run in over the coal storage tank in the boiler room, and partly to fill in on the shore and keep the wave action from undermining the bluff. This arrangement allows the condensers to stand on the lower or boiler room level, which is only six feet above the lake level. This distance may increase, however, to 8 feet in case of low water.

The coal is dropped through suitable gratings from the cars into the coal storage tank, which extends the entire length of the building, and some 30 feet extra. From this tank chutes extend to the magazines of the Murphy stokers. These chutes are hung like the platform of a scale and the coal, after being run in, is weighed before it is allowed to drop into the magazines. This arrangement entirely dispenses with all handling of coal, and at the same time an accurate record can be kept of just how much is required each day.



A CORNER OF THE ENGINE AND DYNAMO ROOM, LORAIN & CLEVELAND R. R.

The boiler room contains two batteries of Sterling boilers, each battery having two 300 h. p. boilers. These are equipped with Murphy stokers. Space is left in the boiler room for 900 h. p. more when required, which will make a total boiler capacity of 2,100 h. p. These boilers are capable of carrying 150



pounds, or even 175 pounds of steam, although the plant at present is running with 135 pounds pressure.

THE ENGINES AND GENERATORS.

The engine room at present contains two cross compound Corliss engines made by the C. & G. Cooper Company, of Mt. Vernon, O. The cylinders are 20x36x48 inches and the engines run 80 revolutions per minute. They have 20-foot fly wheels, weighing 60,000 pounds each. Direct connected to these engines are two 400 k. w. Siemens & Halske railway generators, wound for 630 volts at no load to 700 volts at full load.

The appearance of these units is shown in the engravings. The steam piping is carried to and from the engines under the floor, iron plates being provided for accessibility between the cylinders. This arrangement is preferable on account of the traveling crane, as well as because of the location of the boiler room 22 feet below the engine room floor.

THE LORAIN & CLEVELAND R. R.—PLAN AND SECTION OF POWER HOUSE.

E. P. Roberts & Co., Consulting Engineers.

Between the engine foundations and the fireproof middle wall is the pump pit, containing the pumps and the bulk of the piping. In this pit are the vital features of the plant, and the whole arrangement is so planned by duplication and by-passing that no ordinary accident can possibly cripple the running capacity of the plant.

A wing is extended from the southwestern corner of the plant and this contains the switchboard, a coat room and wash room, and a small work room. Sub-foundations are put in for the addition of one 800 k. w. unit in the future.

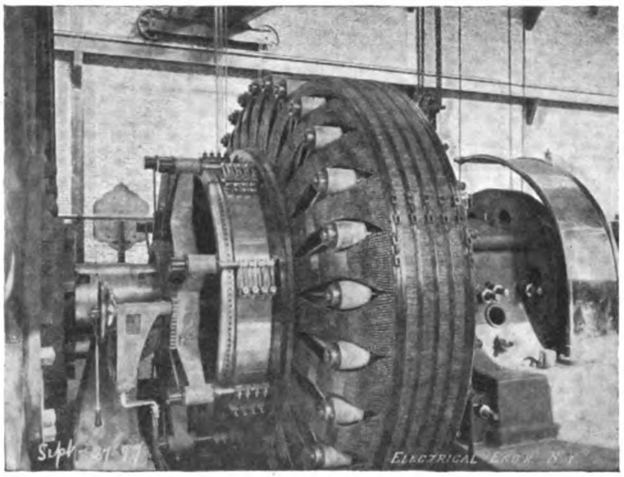
The engines are fitted with double eccentrics on both high

and low press cylinders, and have each two governors, one to operate the release valves and the other to release a weight which operates a butterfly valve in the steam pipe, cutting off the supply of steam when the engine increases speed more than 10 or 12 per cent. The falling of this weight throws a circuit breaker in the main generator circuit, so that the whole apparatus will come to a standstill.

THE STEAM PIPING, PUMPS, ETC.

The steam piping is arranged to run in several ways, either condensing or non-condensing, with either or both cylinders using direct steam; that for the low pressure cylinder passing through a reducing valve.

There is a complete oiling system for both cylinder and lubri-



SIEMENS & HALSKE GENERATOR, LORAIN & CLEVELAND R. R.

cating oil, the oil being fed into the lines from tanks located in the boiler room. Lubricating oil drips are carried to an oil filter in the basement and pumped into the tanks again. The cylinder oil is separated, as far as possible, in a reservoir, and automatically collected for further use. A Musgrave column is used in connection with the sight feed lubricators for the cylinders. Hand pumps are also provided. The butterfly valve also has a small hand pump. The main steam valves are controlled by floor stand wheels.

There are, for each engine, the necessary gauges, 12 inches in diameter, mounted on enamelled slate boards, resting on pedestals. There is also a main gauge board on the middle wall, which has in addition to the usual instruments an 8-day clock and a Bristol recording gauge.

In the pump pit are located two Blake twin vertical air pumps, 10x22x15 inches. It is intended that normally each condenser shall operate with its own engine, but a cross connection is provided so that either condenser may be used for either or both engines. A small Blake low-service pump takes water from the hot well and delivers it to a Stilwell vertical open heater. From here it is pumped into the feed water main by one of two Blake duplex outside packed plunger pumps.

The supply of water from the feed water main to each boiler is regulated by Thomas governors.

All the pumps are controlled by Fisher governors. The service pump is located between the air pumps and furnishes ample water supply for the entire settlement. It can be operated also as a fire pump, and is ready to throw three 1⅞-inch fire streams at a moment's notice. There are at present three Ludlow 2-nozzle hydrants in the system.

The high pressure piping is all extra heavy flanged, with tongue and groove joints. Copper gaskets are used. The covering is Keasbey & Mattison's magnesia sectional covering. The low pressure piping is standard weight, covered with magnabestos. The valves for high pressure are Crane's extra heavy bronze seated, the larger ones being by-passed. The angle and globe valves are of the Jenkins type.

The intake and overflow pipes are cast iron, 20 inches in diameter, and lie in a trench below the floor in the boiler room under the breeching. The intake, or injection pipe supplies the condensers, and takes its supply from the cold well. The discharge and blow-off pipes run into the lake.

THE SWITCHBOARD.

The switchboard is of enamelled slate and is equipped with the usual instruments, including a Weston illuminated dial ammeter for each generator, and one for the total out-put, six Weston round dial ammeters for the feeders, a Weston illuminated dial voltmeter for the bus-bars, and a Weston illuminated dial differential voltmeter to be used for throwing the generators in multiple. There are also a Bristol recording voltmeter, and a General Electric recording ammeter. Special provision is made in the matter of ground wires to track and water pipes.

An even illumination of the switchboard is obtained by lighting it from above, similar to the scheme used for lighting pictures in art galleries. The setting of the switchboard flush with the wall with plenty of room behind it, as well as plenty of light, is a plan that recommends itself at once, especially where a traveling crane is used.

The bus-bars on the board are so designed that additional strips can be added when the additional generator is installed. The board has also six feeder circuits in three panels and a lighting panel, in addition to the generator panels. The lighting panel has several circuits, one each to the car house and grounds, as well as the one in the power house.

THE BUILDING.

It will be noticed that the building is something more than a mere shed. It is architecturally pleasing, and the 200-foot stack is also an excellent piece of construction. Both these are very substantially built and fireproof throughout. The boiler room floor is cement and the engine room floor is also cement, supported by hollow arch tile and steel beams. Large openings are left in the engine room floor over the condensers, through which a view of the pump pit can be had. There is also an opening for stairway from below. In the boiler room a light bridge connects the engine room with the top of the coal tank, steps being led down to the top of the boilers and the top of the Murphy stokers. Galleries run along the piping in the pump pit and over the boilers for easy access to all valves.

The 15-ton traveling crane was furnished by the Cleveland Punch & Shear Works, and has two 8-ton trolleys, with triplex blocks. The span is 54 feet 6 inches. The crane has roller bearings throughout and cut gearing.

OFFICERS AND CONTRACTORS.

The officers of the company are: B. Mahler, president; E. G. Tillottson, vice-president; E. W. Moore, treasurer; J. C. Hoge, secretary; F. W. Coen, assistant secretary; W. E. Davies, superintendent.

One of the prominent members of the company is Mr. C. W. Wason, who is well known to electric railroad men, not only because of his connection with Cleveland roads, but because of his interests in other cities. Mr. Wason acted as general consulting engineer for the entire work. Mr. A. P. Ruggles acted as chief engineer for the road. The power house was intrusted to E. P. Roberts & Co., consulting engineers. Mr. J. N. Richardson was retained by E. P. Roberts

SWITCHBOARD, LORAIN & CLEVELAND R. R.

& Co. as architect for the power house, and afterward by the company for the car house.

The iron and steel work in the power house was designed by the Osborne Company, who also had charge of the inspection of all iron and steel for the road and that used in the boilers.

The Chase Construction Company, of Detroit, were the contractors for the line work. L. Dawtel was mason contractor for power house and car house. J. W. Vanderwerf was contractor for woodwork for power house and car house. The Forest City Wire and Iron Company were contractors for structural steel in both power house and car house. Messrs.

Chafer & Becker were contractors for all steam and water piping and the water tank.

THE BALLSTON TERMINAL RAILROAD.

Considerable interest is being manifasted in the completion of the Ballston Terminal Railroad at Ballston Spa, N. Y. This road has been contemplated for some time, and within the last three months, under the energetic management of Mr. J. C. Stanton, gives evidence of early completion.

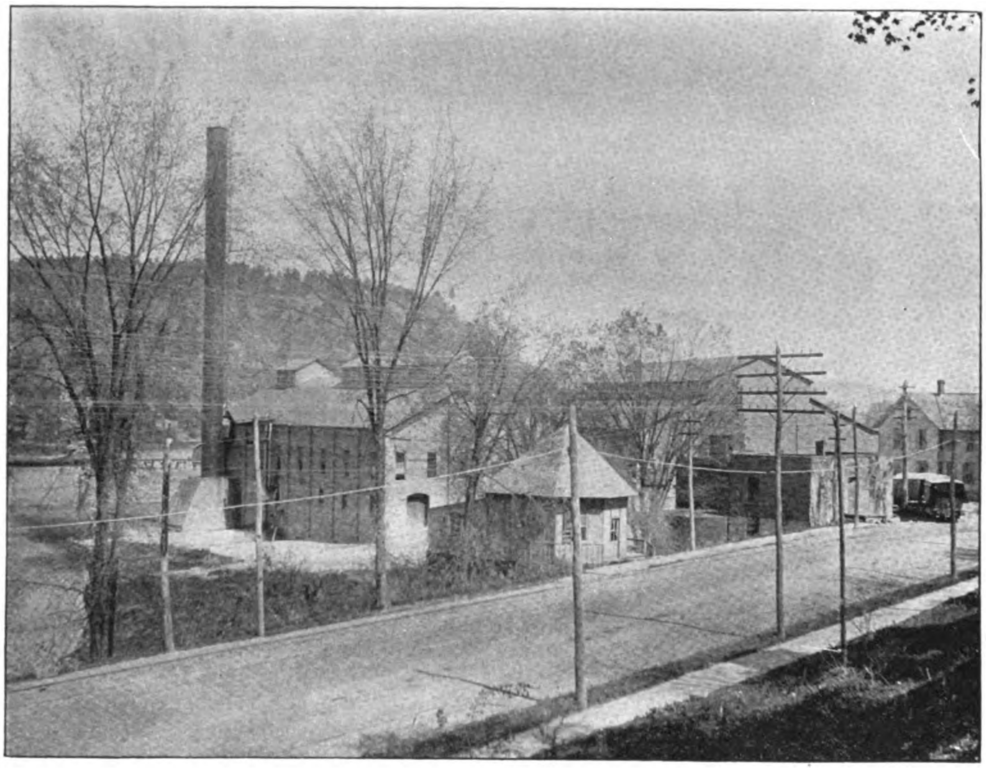
The power house, which is a commodious and substantial structure, of modern ideas, is now completed. The apparatus consists of Babcock & Wilcox boilers, Hamilton-Corliss engines, Westinghouse Electric and Manufacturing Company electrical apparatus, J. G. Brill Company cars, Mayer & Englund overhead material, the delivery of which is now going on, and the road bids fair to be fully completed before the close of next month.

The road is largely a freight road, which will handle the freight by electric locomotives designed especially for the Ballston Terminal Railroad, and are now being erected at the car works of J. G. Brill Company, in Philadelphia. The passenger service will be taken care of by the ordinary passenger cars.

THE BINGHAMTON, N. Y., ELECTRIC RAILROAD.

BY HARRY N. GARDNER.

ANY one who doubts that the Binghamton, N. Y., street railway was one of the first lines equipped with the subtle "juice," will have his doubts removed by looking at the old



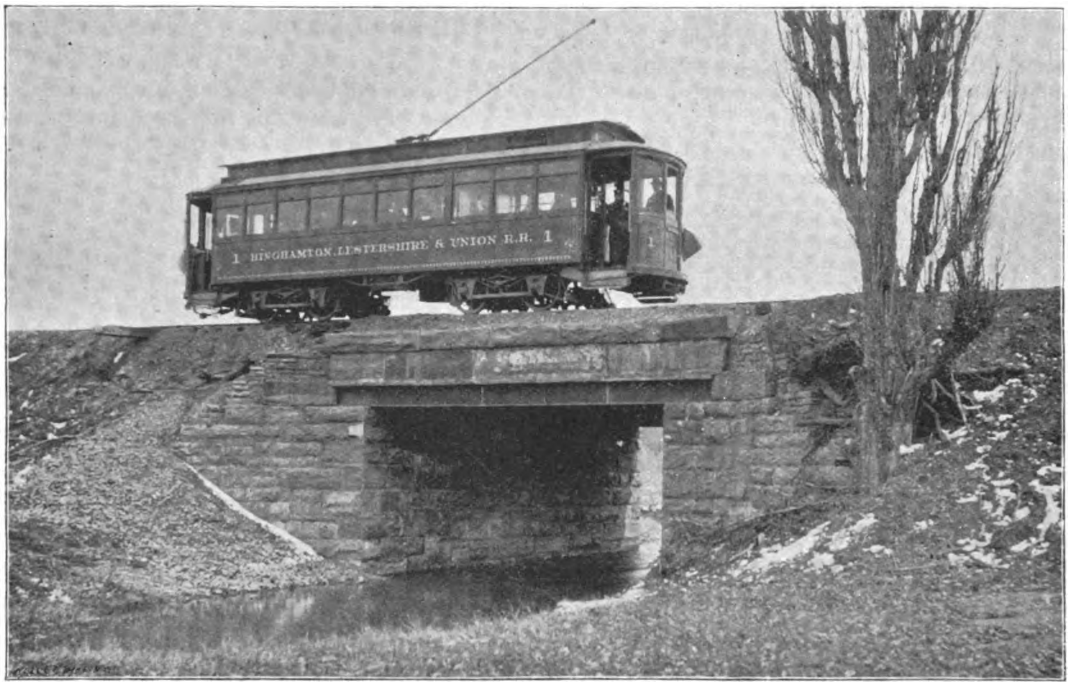
Power Station and Car House, Binghamton, N. Y., Railroad.

Van Depoele motor standing in the power house of the present Binghamton Railroad Company, which drives the planer, lathe, drill, cut-off saw and grindstone for the company's repair work. This is one of the motors that used to stand on the platforms of the old horse cars that were converted into the

The Casino, on the Line of the Union Railroad.

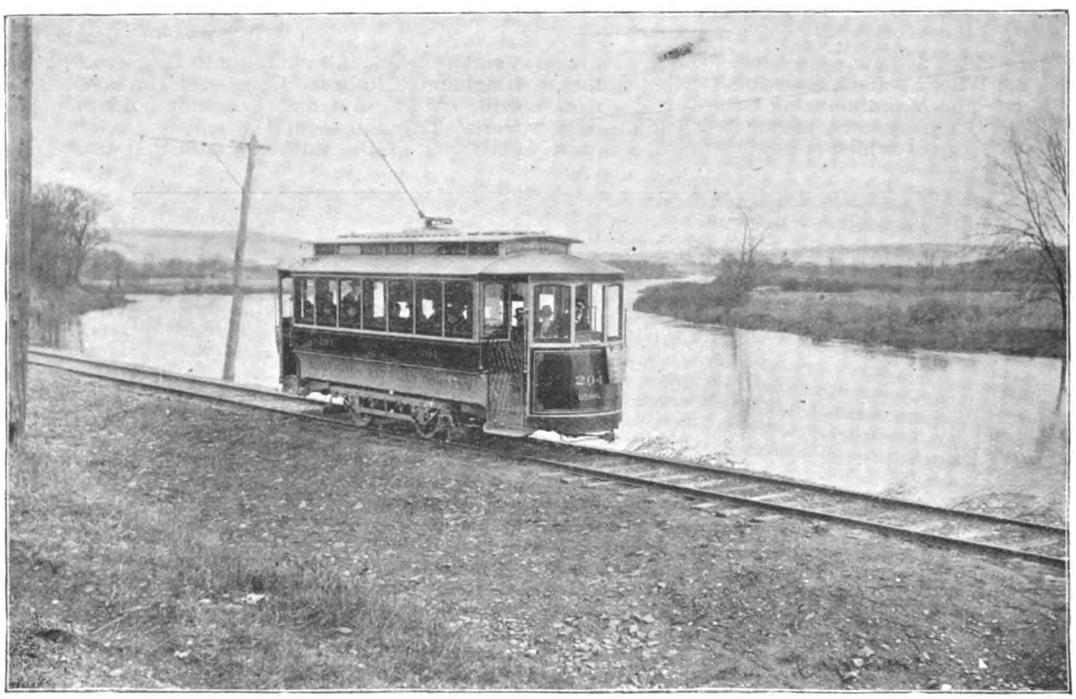
first electric cars, and caused citizens to open their eyes at the "no-pushee-no-pullee" methods of the "broomstick train" and wonder "what they are going to do next." What they did next was to take the electric motors from the car platforms

and put them underneath the cars, and in the improvements that rapidly followed each other after the first introduction of electric traction, the Binghamton Railroad Company always kept step. But the old Van Depoele motor managed to stay on top; and after it had passed its usefulness for car propulsion, it was relegated to a corner in the machine shop, where it was less in the way than on the car platform, and has since been used to drive the machines of the shop.



A CULVERT ON THE LESTERSHIRE AND UNION LINE.

Before the introduction of electric populsion there were eight different street railway companies holding franchises and operating in the City of Binghamton. After electricity demonstrated its usefulness for this work, these old horse car lines were, one after the other, absorbed, and the more economical current substituted for horse-flesh, until, in 1892, the Binghamton Railroad Company owned the equipment and franchise of every line in the city. Under the financial management of Mr. G. Tracy Rogers, the president of the company, a system of improvement was inaugurated, which was carried out under the supervision of Mr. J. P. E. Clark, the general manager, until to-day this company will compare favorably with any other of the kind in the country.



A PICTURESQUE SPOT ON THE BINGHAMTON RAILROAD.

THE POWER HOUSE.

Starting with the power house for a description of its present equipment, we find a brick building, 65 by 128 feet in dimensions, with an iron truss roof, covered with slate. In the northeast corner of the building are the general offices of the company. The remainder of the east end of the building,

which forms a part of the engine and dynamo room, is used for a winding and electric repair room, the company doing all of its own repair work. The two panel black marble switchboard is also located in the southeast corner, thus placing it where it can be easily looked after by the electric repairman, who is usually at work close by.

The engine equipment consists of two tandem compound condensing Ball & Wood engines, rated at 150 h. p. each, and one cross compound engine of the same make, rated at 250 h. p. The surface condensers are in the basement, nearly under the engines. The water for the boilers and condensers is drawn from the Chenango river, on the bank of which the power house stands. The two smaller engines are each belt-connected to a 100 k. w. Edison bipolar dynamo, and the larger one is connected in the same way to two 80 k. w. dynamos of the same type. While these dynamos are not of the latest design, they have been, and still are, remarkably serviceable and efficient machines. The dynamos are run in multiple, the leads and equalizer wires being carried beneath the floor to the switchboard.

The circuit of each machine, as well as the nine feeder circuits that lead from the switchboard, are protected by magnetic blow-out circuit breakers. The boiler room is located at the rear of the engine room, and contains three return tubular boilers, each with a rated capacity of 150 h. p. The fuel used is buckwheat coal and screenings mixed. A daily record is kept of the coal used, the number of hours the boilers are in use, etc.

THE CAR EQUIPMENT.

Close to the power house is the car house, a wooden building 130 by 118 feet in size, covered by a corrugated iron roof. There are three repair pits in the building. Another car house of the same size, for storing cars not in use, is located on the Asylum line at the outskirts of the town.

The car equipment consists of 90 cars, of which 2 are open cars, 47 feet in length, seating 90 passengers each, and one is a combination car, seating 40 passengers. The rest are cars of different sizes, from 16 feet in length up. Forty of these are motor cars, 25 have bodies for motor trucks, to be transposed with the seasons, and 25 are trailers. There is also one double track and one single track snow plow and one snow sweeper. The motor equipment consists of T.-H. W. P. 30's and 50's and G. E. 800's.

TRACK CONSTRUCTION AND ROUTES.

For the track construction 48-pound T rails are used for suburban and unpaved streets. For the standard city work in paved streets a 9-inch, half grooved rail is used, that weighs 96 pounds, and for special work a 117-pound rail is used. Heavy 8-bolt fish plates are used, and the bonding consists of both double and single bonds (according to location) of No. 0 wire.

There are over thirty-four miles of track laid through over twenty-five miles of street. In some of the heaviest traffic streets double tracks are laid, but most of the lines are single track, with turnout switches. The line leading from the depots through the principal business streets to Lestershire, a distance of over three miles, is double-tracked for the entire distance. Every one of the eleven lines diverges from Court street, the principal business street, from either the corner of Washington or State streets, two parallel streets but a short block apart. As there are several lines traversing State and Washington streets, it is so arranged that all south-bound cars pass through State and all north-bound ones through Washington street, thus obviating the necessity of further obstructing those streets with double tracks. Port Dickenson, three miles to the north, and Union, nine miles to the west, are the extremes to which the lines reach.

In most cases 2 of the 11 lines are included in a run. Instead of stopping at one of the two diverging corners, most of the cars simply run through the central part of town at these points. Thus one run is from the State Hospital to Ross Park, another from Upper Chenango street to the Susquehanna Valley Home. Broad avenue and Floral Park Cemetery are included in another run. The crews are changed about on these runs every week. Cars are run on most of these lines every 15 or 20 minutes, and in a few instances every half hour, but as the lines diverge from the business centers, several lines using the same tracks for some distance, it gives more frequent service for important streets; thus, on Main street, or to the depots cars can be taken every five minutes or oftener.

There are few cities that cover as much area as does Binghamton that have such a network of electric lines. The map of the lines shows that within the city limits there is no point that is more than four blocks from a car line and few places as far as that. A 5 cent fare is charged, and transfers are given on all lines but that to Union.

LINE CONDUCTORS.

Direct current without boosters is used for operating all of the lines. The power is taken from the station by nine feeder circuits. No. 0 is used for the trolley wire. In most cases No. 4-0 wire is used for the feeders, but for the Union line a 500,000 circular mils cable is used. It is tapped in at the first place some distance below Lestershire. As Union is nearly 10 miles from the power house, and the Casino 9, it necessarily follows that the voltage drop and power loss for short periods is considerable, especially when several are starting from the Casino at once. This has caused little inconvenience, however, except the necessity of slower running. No burnouts have been attributed to the excessive current taken by the motors at such times.

ATTRACTIONS FOR STIMULATING TRAFFIC.

One policy followed by this Company, which they have found to be a profitable one, is to furnish various attractions that will lead people to patronize the lines. Ross Park, situated nearly two miles from the center of town, is owned and maintained by the city. It is a wooded retreat, containing 100 acres, with attractive dancing, eating and other pavilions situated in the ravine that runs through it. The Street Railroad Company has done much to help beautify the place, and they furnish various attractions. The Park Amusement Company, composed of officials of the railroad, control the merry-go-round, switch back, restaurant, etc., which are, of course, paying investments. But nearly every afternoon and evening during the summer, free band concerts are given, as well as free vaudeville shows, and performances by Japanese and Hindoo jugglers, trapeze and other acrobatic performances, fireworks once or twice a week, and other like entertainments.

Although these attractions cost the Company from $250 to $300 a week, it can be seen that they pay when it is known that almost every pleasant summer day from 1,000 to 3,000 people are carried on this line, and upon special occasions as many as 8,000 people, making 16,000 fares, have been taken to that resort in one day. This park is the objective point of many out-of-town excursions, frequently three or more excursions visiting it in a day.

THE UNION EXTENSION.

Power Station of the Union Railroad.

Lestershire is a suburban town three miles from the center of the city. Two years ago the Company decided to extend their Lestershire line six miles further, to Union, a small town of about 1,000 people. It was generally predicted that this would be a losing venture, but the road was built, and although it was opened late in the fall, the line has been the best paying one operated by the Company from the first.

During the first winter many people took the trolley ride to Union "to see the new line," and supper and dancing parties at the Union hotels became quite popular. Before the novelty of the thing had worn off the Company purchased a tract of land near Union, past which the line ran, and converted it into a popular resort, so that winter and summer there are attractions to take people over the line in addition to the regular patronage of residents along and at the terminus of the road. At Casino Park, as the place is called, a bicycle race track, ball ground and picnic ground along the river bank were laid out. The principal attraction is the large Casino pavilion, the grounds in front of which are laid out in attractive lawns and flower beds. The pavilion contains a restaurant, cream parlor, etc. The main floor can be used for dancing parties, or it offers an attractive place for a person to sit and enjoy the refreshing breeze while looking upon a beautiful view of the Susquehanna. A stage is erected at one side, and nearly every summer afternoon and evening free concerts and vaudeville shows or other attractions are furnished. The line is divided into three sections, the fare for each being 5 cents; a round trip from the city costs 25 cents.

Concerning the ride from Binghamton to Union, much of the way along the river bank, a prominent contractor of Buffalo, who travels a great deal, said a few weeks ago, as he rode over the line: "I know of no trolley road in the country that offers as pleasant a ride as this, passing, as it does, well kept farms and most of the way through roads, flanked on either side by large shade trees, and along this beautiful river."

In constructing this road the public highway was followed most of the way, although at one place, to avoid crossing the

steam railroad twice, a private right of way was obtained for some distance. In crossing this two long trestles were found necessary. The line was completed with a maximum grade of 2.9 per cent., although in order to accomplish that result the highway was in several places cut down or filled up for short distances, so that where farmers' teams formerly drew their loads up a 10 per cent. grade, a 3 per cent. one is now encountered.

The heaviest grade on any of the lines are two of some length in ascending to Ross Park and to the State Hospital, the one of about 5 per cent., and the other of 8.

THE MANAGEMENT.

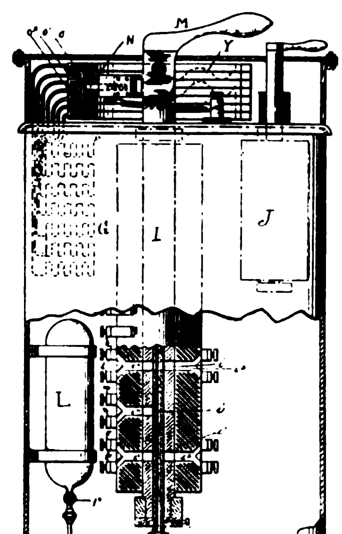
Gen'l Sup't J. P. E. Clark.

General Manager J. P. E. Clark has the reputation of being the busiest man in the city, and also of being everywhere present. It is largely owing to his enterprise that the operation of the road has been so successful. Although he attends to so much, he has reduced the work of the Company to a perfect system. A record is kept of the number of passengers carried on every car and by every conductor, the number of miles run by every car, just what each car costs for repairs, and all the other details that enable the manager when he goes to his office in the morning to tell just what was the work of the previous day, and what to expect of the day to come.

THE HENRY CAR CONTROLLER.

DURING the evolution of the railway motor, the subject of controller design has been one of the most stubborn problems which inventors have contended with, the main difficulty being in providing means to suppress the destructive arc and to avoid losses from idle resistance.

The accompanying illustration represents a new arrangement recently patented by J. C. Henry, of Denver. The controller consists of several well known and advantageous methods of controlling motors and cars and uniting them in a single instrument capable of operation by the same handle. In addition to controlling the supply of current to the motors in an economical way and providing an ideal electric car braking system, the energy of momentum when coming to a stop, or that of gravity when descending grades, is recouped and turned back into the line to assist the station dynamos.



THE HENRY CAR CONTROLLER.

The field magnets of the motors are connected in series and are independent of the armature circuits. Their strength is varied over a wide range by a rheostat in the shunt or separately excited circuit, while the armatures are manipulated from parallel to series in the well known way. When braking the cars those available means of increasing the motors' voltage above that on the line become exhausted, which they would in ordinary street railway practice at a speed of about five miles per hour, the motors are then smoothly brought to a stand by short circuiting their armatures under the variable magnetic field. The controller is so arranged that a forward movement of its handle smoothly decreases the voltage of the motors, and consequently increases the amount of current to the armatures, while a backward movement increases the motors' voltage, so that they are not only capable of resisting the passage of current from the line, but aid the stationary generators as long as the motors are driven forward by momentum or gravity.

In using separately excited or shunt wound motors as proposed, the arc formed when the trolley leaves the wire, or when the armature circuit is broken, is very small when compared with that of series motors—probably not over one-fifth the length. This greatly simplifies the construction of the controller, as it avoids the necessity of supplementary arc breakers. When higher than the ordinary voltages are used, the switching is all done in a closed receptacle containing carbonic acid, or some other easily generated gas, incapable of supporting combustion. If still higher voltages are to be dealt with, it is proposed to emit a jet of the gas under heavy pressure against the arc, and thus quickly obliterate it by mechanical displacement and by the intense heat absorbing force of the gas. With such a system of braking, it is obvious that there would be no wear on the wheels or brake shoes, and such expensive and disagreeable things as flat wheels would not exist.

In the accompanying engraving the handle M is moved in both a vertical and horizontal direction; the latter movement controls the armature circuits, while the former regulates the resistance G, on the field circuit. L represents a flask containing the gas under pressure.

CAST-WELDED RAIL JOINTS IN CHICAGO.

SOME of the experience of Chicago roads with cast-welded rail joints was reported in the course of an informal discussion at the meeting of the Chicago Electrical Association on October 1, though no one offered to explain why it is that long stretches of cast-welded track give no trouble when subjected to the changes in length which all rails are supposed to undergo with the variations in temperature during the different seasons. When these joints were first used at Chicago it was supposed that it would be necessary to have an expansion joint at least once in every thousand feet, but in practice it has been found feasible to have stretches up to four miles long continuously welded, with a breakage of only ½ of 1 per cent. of the joints during the course of a year. Probably the tight fastening of the rails to each tie tends to check the expansion and contraction, though Mr. Knox cited a case to show the powerful strain tending to produce such changes in length. A strip of track two miles long had been cast-welded during a hot spell; then, when a cold wave came on with some cooling rains, the rail broke off squarely at a point which showed a flaw in the steel, and opened up a gap 1¾ inches long!

As to the effectiveness of these cast joints as conductors, it was reported that the earlier ones left much to be desired, because the rail ends were never clean enough to avoid the formation of a high-resistance layer between rail and casting. Lately it has been found feasible to clean the rail ends with sand-blast by means of an electrically driven blower. Such blowers were reported to be quite economical, using only a yard of sand for from 30 to 35 joints; and as the blast penetrates even the pock-marks on the rail, it leaves the metal clean and ready to amalgamate thoroughly with a proper cast mixture. Then, as the casting cools first at the surface, it presses the molten metal tightly into the crevices on the surfaces of the rail and forms a solid joint of extremely low resistance.

NO TOBACCO.

Wilmington, Del., following the lead of Boston, is moving for more gentlemanly conduct on the part of employees of transportation companies. The New Castle Electric Railway Company has just issued a general order prohibiting its employees from using tobacco in any form while on duty. Whether the rule will be rigidly enforced it is yet too early to judge of its results.

MODERN COMPRESSORS FOR AIR-BRAKING.

BY E. J. WESSELS.

ALTHOUGH compressed air was known in Aristotle's day, and has long been used for a variety of work, its application in the field of electric traction remained in an undeveloped state until recent years. So long as horse cars were the order of the day, no necessity existed for its use in braking surface cars. Shortly after the first electric car was put in service, the company, of which I have the honor to be managing director, met the need which arose by furnishing an air-brake system, operated by a single double acting compressor, for controlling electric and cable cars.

As electric traction developed, increased demands were made upon us for apparatus of higher efficiency than had sufficed in the dawn of street railroading. As a result, not only had existing conditions to be confronted and met, but, what was fully as important, a system had to be evolved which would successfully meet the radical changes which became necessary. The air-brake system really had to be ready before the need for it had become fully apparent. No time was granted for experimenting, after the high efficiency car motors were in place.

With these special needs in view, an electric compressor embodying radical changes had to be designed. Many experiments were made with the initial outfits and large outlays were necessarily incurred, without always being followed by satisfactory results. It may be admitted with perfect frankness that the first apparatus left much to be desired. We had to rely upon the reports and friendly criticisms of railway managers in order that defects might be cured and that each installation might be an improvement upon its predecessor. Some of our friends realized that their interests and ours were very closely allied and through them we obtained important help.

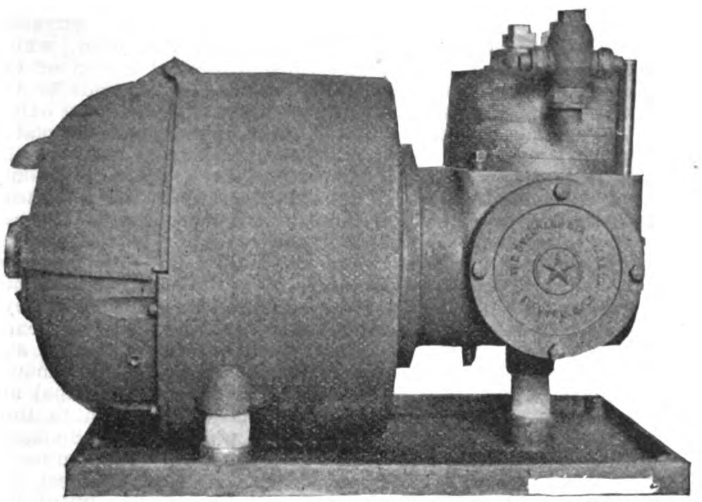
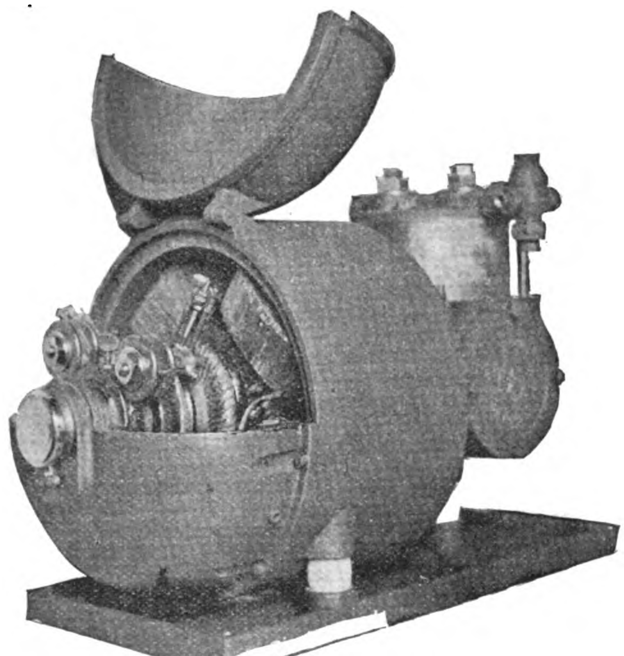
The problem of braking by air, high speed, heavy cars running in trains, is not as simple as might appear at first blush to the uninitiated. It becomes more complicated when the factors of heavy grades, frequent stops and numerous crossings are involved. A motor compressor which answered in 1895 falls short of the requirements of 1897. With a full appreciation of this fact our Company's aim has been ever to keep in the van.

The illustrations accompanying this article are not "manufactured," but taken from real life, and represent the interior and exterior of our latest machine as actually photographed. Reference to some of its features may be timely and it will be seen wherein this type of air compressor differs from all others. The illustration shows the 1½ h. p. type. The motor compressor is very compact, being but 26½ inches long by 15 inches wide by 18½ inches high. The complete weight is 400 pounds. The motor is of the iron-clad, multipolar, slow speed, series type. It was found after repeated experiments that the use of gears necessitated a much bulkier machine and that the noise arising from a geared machine was very much greater than from the other type. This noise was intensified after the gears showed wear. For this and other reasons the geared type was abandoned.

While our motor is absolutely rain and dust proof, nevertheless the construction is such as to make the brushes readily accessible. It will be noticed that the commutator is of very generous proportions, as are also the brushes. Special brush holders are provided, which are exceedingly convenient. Their long springs insure even tension of the brushes and require only very infrequent adjustment. The wide insulating surfaces prevent leakage through "creeping." In this motor extraordinary precautions have been observed throughout for obtaining the strongest and most durable insulation.

While the armature is of the slotted drum type (such as is used in the best sort of street railway motors), the winding is special, being of the well known Hochhausen type. It should be stated that ours is the only company which is authorized to use the Hochhausen patents in air compressor work. Damaged sections can be renewed (in case of injury), as is common on car motor armatures. The machine is thoroughly protected against ingress of oil from bearings and compressor.

The compressor is of the single-acting type, with double cylinders, which are placed vertically, with trunk pistons connecting directly to eccentrics in the crank case. The pistons are carefully balanced to insure a minimum of noise and freedom from vibration. The eccentrics are effectively lubricated by revolving in a closed chamber partly filled with oil, which is kept at such height as always to be in contact with the sliding surfaces. The compressor is bolted to the end of the motor and the shaft is a prolongation of the armature shaft, although it does not form a part of it.

THE STANDARD AIR COMPRESSOR FOR ELECTRIC CAR BRAKING.

The compressor has a capacity of 11 cubic feet of free air per minute when working under a gauge pressure of 60 pounds per square inch. It is capable of operating with great economy even at 100 pounds pressure, although in straight air work the maximum pressure required by the Standard system is 60 pounds. The remarkably high efficiency of the compressor is largely due to the design of the valves. These combine ease of access with a minimum loss arising from clearance. Being made of steel, they are very light, and are practically indestructible. The air supply is drawn from a chamber, which, although dust proof, has so large a filtering surface that the work of drawing the air through the same is inappreciable.

This modern motor compressor has been in operation for a number of months and has been mounted on a number of cars with very satisfactory results. The operation is completely governed by the automatic current controller, which relieves the motorman of responsibility by starting the motor compressor when necessary to replenish the air supply, and by cutting out as soon as the needed supply has been obtained.

In view of the recent advent of the third rail and Sprague systems, he, indeed, would be a bold prophet who would undertake to predict what the next five years may have in store for the traveling public. But it is safe to assert that, no matter what form of electrical construction may become the recognized standard of the future, the modern air compressor will be found doing its work of maintaining a sufficient air supply (in connection with an air-brake system) to curb the

speed of what would often otherwise prove "wild" trains or cars. For such work it is singularly well adapted, and its place is not likely to be usurped by any other forms of braking apparatus.

THE LATEST METHOD OF ELECTROLYSIS PREVENTION.

BY HAROLD P. BROWN.

DURING the past two years the writer has had extensive dealings with European and Australian electric tramways and has thus become somewhat familiar with foreign methods of guarding against electrolysis. Municipal authorities in Europe are not content to wait until the underground pipes have been damaged before giving the matter official attention. On the contrary, eminent electrical engineers were long ago consulted as to the cause of the trouble and with their guidance stringent rules were adopted with which the tramway companies must comply.

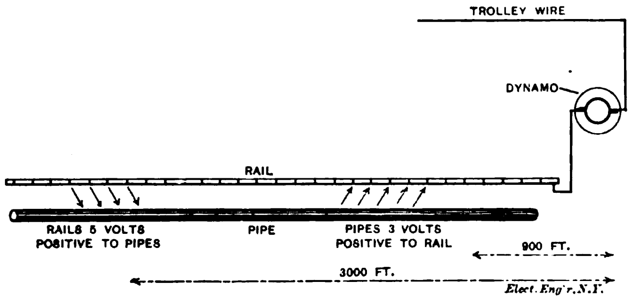


FIG. 1.

Early in the history of electric lighting the same course was followed, but in that case the regulations of the English Board of Trade were so severe that for years corporations could not profitably operate in accordance therewith. In consequence the business was practically stagnant until experience in this country had shown that the restrictions could be relaxed without danger. The regulations of the same board concerning the operation of electric tramways are, from the American point of view, needlessly severe and few, if any, of our electric roads could operate under them with present equipment. On the other hand, the English authorities must regard with amazement the neglect of many of our cities to protect their own underground property. Between these two extremes is a golden mean which, in the opinion of the writer, should be carefully determined by a committee of experts who have had practical experience in the matter.

The English rules act in two ways to check electrolysis: they permit but a small percentage of the railway current to return through the earth, and they limit the difference in electrical pressure which may exist in the rail return circuit. The rules do not lay down methods to be followed in getting the desired results, but their narrow limits force the tramways to maintain a perfect rail return and to employ the most expensive systems of electrical distribution in order to cover large areas. Registering instruments are used to detect any failure to obey the rules, and the responsible officials or employés are fined and the current may be cut off if the fault is not corrected within twenty-four hours. In this country things are managed differently!

For the benefit of those not familiar with the subject, a brief explanation of the cause of electrolysis may not be out of place. When an electric current passes from one metal plate to another through a conducting chemical compound like water, the fluid is decomposed; its oxygen appears at the positive plate from which the current flows, and its hydrogen at the negative plate. If the positive plate will oxidize, it is corroded by the oxygen. Of the metals ordinarily used for pipes, lead will corrode more rapidly than wrought iron and the latter more rapidly than cast iron. Lead service pipes and lead joints in water and gas mains are therefore the first to show injury from electrolysis. It is well understood that the current to operate the electric cars is carried from the dynamos to the trolley wires, and after doing its work in the motors, passes through the car wheels to the rails. The current then follows the pipes, doing injury at every defective joint, until within a short distance from the power house, when it again passes through the earth to the rails and thence through wires to the dynamos. The course of the current is shown in Fig. 1.

The greatest damage is done to the pipes at the point where the current leaves them, and these points can be determined by electrical measurements on the surface of the street. The rate of corrosion is in direct proportion to the difference of electrical pressure between the pipes and the rails. The entire trouble is caused by the fact that the path for the current through the rails is a poor one and grows poorer every day. If the rails were absolutely continuous lines of metal, the rate of electrolytic corrosion would be slow. But every thirty feet the rails end and the circuit is broken, since the oxide of iron on the rails and joint plates is practically an insulation. Attempts have been made to obtain continuous rails by electric welding, but this process on account of the necessary flux, not only fails to make an electric joint of low resistance, but also decarbonizes and softens the metal to which the high heat has been applied, thus producing in a short time two low spots at every joint.

Great conductivity has been claimed for what is called the "cast-weld" joint. This consists in pouring melted iron into a metal mould placed around the rail ends, which is supposed to form a weld of low resistance. Though this is an excellent mechanical joint, it is a poor conductor, as is proved by the recent discovery in Chicago of badly corroded gas and water pipes under double tracks of very heavy rails which had "cast-welded" joints, and were also provided with two large copper bonds at each joint. These were put in about two years ago and were thought to make an electrically continuous rail, but the pipes tell a different story.

There are very many types of copper bonds for making an electric contact between rails, ranging from old bits of wire roughly rivetted into holes in rails, up to flexible strips of copper bands or cables with elaborate clamps or contact devices. But there are three forces always at work, to destroy a copper bond: first, heat, since the different ratios of expansion of steel and copper will spoil the contact surfaces; second, the pounding of the car wheels at a joint, which makes the copper brittle; and third, chemical action of the moisture in the earth on the two metals. This tends to dissolve the copper and to coat the steel heavily with iron oxide. So powerful is this action in certain soils that even tin plated copper wires one-half inch in diameter, buried between the rails have been so damaged within three years, that only slight traces of them could be found. Many of our American street railways are built by contractors who have no interest in the economical operation of the road nor in the damage that their poor or cheap work may inflict on city gas and water pipes. Their sole business is to do the construction work as cheaply and as quickly as possible and to get their money.

This class has created a demand during the past two years, for a fifteen-cent copper bond, when safety of pipes and economy of operation require eight or ten times that amount of copper or its equivalent. So some of our municipal authorities are thus idly permitting a practice which in time will produce leaky gas and water pipes, as at Spokane, Wash., in September, or even cause gas explosions similar to the one in Boston a few months ago. At the very best, the results of this work will mean an eventual tearing up of city pavements in certain localities to patch or replace the pipes.

Now this can be to a great extent prevented by requiring that the conductivity of the rail joints in any electric road shall be sufficient to carry the maximum current and by providing for the regular inspection of the joints. One inspector, who need not be an expensive man, if provided with an instrument specially designed for the purpose by the writer, could easily do effective work for 50 to 75 miles of double track. Maps of each line of road should be made on a scale not less than 50 feet to the inch, and a careful record kept of the electrical condition of each rail joint so that each imperfect bond could at once be replaced. This instrument, which was built by the Weston Electrical Instrument Company from the writer's designs, enables one man to obtain an accurate reading of the amount of current passing through the rail and to determine the exact electrical loss at each joint.

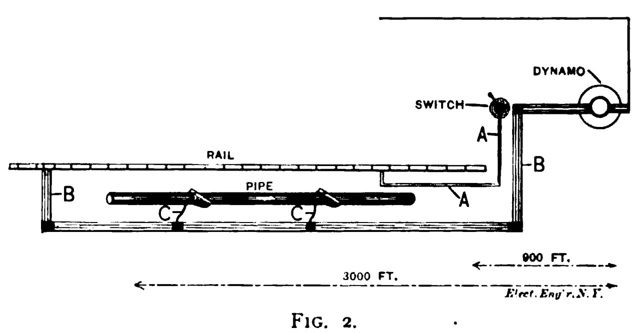


FIG. 2.

Of course, the better the bonding, the less the loss at the

joint and, therefore, the less the trouble from electrolysis of the pipes. The same instrument can be adapted for measuring the electric current flowing through gas and water pipes without cutting them and is the first successful apparatus ever made for this purpose. The first one is to be used in the city of Newark, N. J., by the Consolidated Traction Company, and each division of this large road will soon be provided with a similar one. In addition it is proposed to run pilot wires from the water pipes in various portions of the city to electrical instruments located in the headquarters of the Fire Department where an operator is constantly on duty so that if any dangerous electrical condition of the pipes is indicated, attention will at once be called to it.

Similar instruments are placed on the switchboard at the railway power house so that two independent observers will be always on the watch for trouble. After thus detecting and locating the trouble, the next step is to remedy it. This has been done at Newark under the writer's direction for the past two years, by connecting separate insulated wires from the points on the pipes that were formerly positive, to a separate dynamo at the nearest power house. The pressure on this dynamo was maintained at a higher point than the dynamos connected to the rails. The attendant by varying this pressure can obtain the desired result and absolutely control the electrical condition of the pipes. It must be remembered that the pipes are not injured by electrolysis as long as they are negative to the rails.

After testing this method for the past two and a half years,

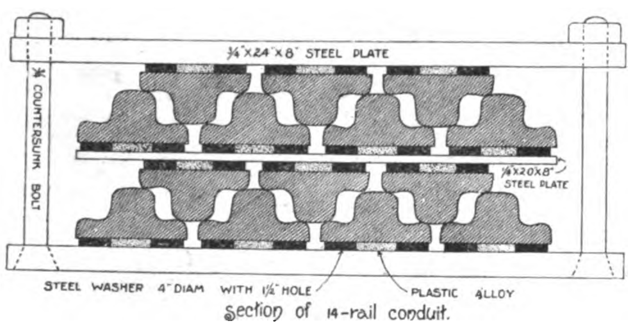


FIG. 3.—METHOD OF BONDING RAILS FOR FEEDERS.

the railway company has made an appropriation sufficient to install an improved method of electrolysis prevention designed by the writer, which, although much more expensive than the one just described, will not require the independent dynamo and will not need adjustment as the load upon the dynamo varies. The method has the additional merit of reducing the flow of current upon the pipes to the minimum. An ample return circuit is connected to the lines of rails nearest to the power house, which is marked AA on accompanying diagram, Fig. 2. The return conductor BB is insulated and has a carrying capacity four or five times greater than AA. It is connected to more distant points on the road where formerly current passed from the rails to the pipes.

In Newark these conductors are respectively about 900 and 2,800 feet long. Each is connected to the negative pole of the dynamos. Insulated wires CC are then connected between the points on the pipes which were formerly positive and the conductor BB. With this arrangement an adjustment is made at time of heaviest load so that the distant end of BB is 4 to 6 volts negative to the distant end of AA. This adjustment is effected by turning a switch at the power house so as to vary the resistance of conductor A. When this is done, the resistances of the wires CC are set so that each pipe connection is about one volt negative to the nearest rail. This adjustment is made in the conduit manhole where wire C joins B.

By these connections the pipes are held permanently in a safe electrical condition, and the current flowing on the pipes is reduced to its minimum. Since this plan requires BB to have great conductivity, and since the proper amount of copper would cost at Newark $30,000 for the bare wire, the company is utilizing as electrical conductors old tram rails, that are worth about $10 per ton as scrap steel. These are placed in a box of creosoted wood which rests on the cemented top of a terra cotta conduit for the feed wires. Every 15 feet the rails are clamped together by heavy plates and bolts somewhat similar to the arrangement shown in Fig. 3.

Electrical contacts between the rails and plates are made every 15 feet by means of the plastic bond, whose material will not corrode nor break nor lose conductivity as time passes. The box is then filled with a liquid insulating compound to preserve the steel.

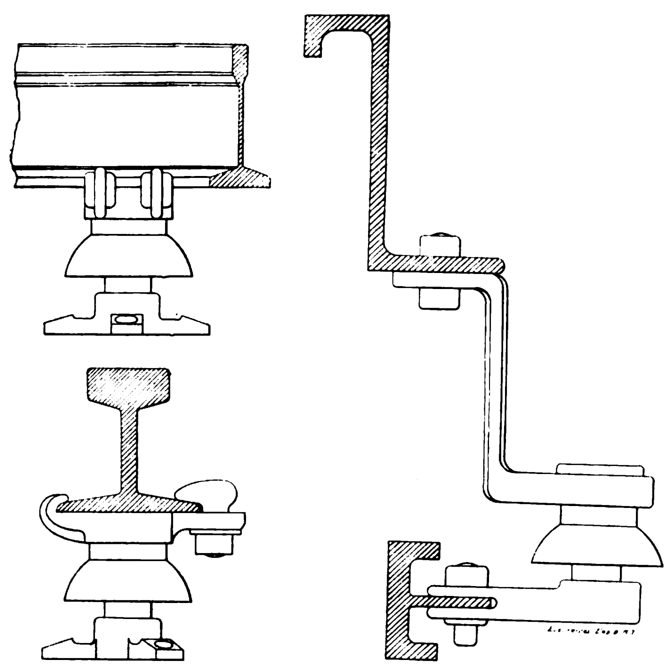
Two conduits of similar rails connected in this way have been in use at Newark for nearly three years without depreciating. The electrical resistance is practically the same as though it were a continuous piece of steel. The new conductor is composed of 16 parallel lengths of a rail weighing 50 pounds to the yard, and it is equal in conductivity to a copper rod having a section of 18 square inches.

Its total cost is about one-sixth that of the copper, or $5,000. With this system in use and with the careful detection of badly bonded joints, electrolytic corrosion of Newark's pipes will be a thing of the past. It is the present practice of railway men to make light of electrolysis. But it is a difficult problem at best and each place presents new complications. In many cities where there are several systems of pipes, it is necessary to protect against current flow from one set of pipes to another, and this flow may occur at any part of the city. Cases have been observed where the electrical pressure between gas and water pipes in a house was sufficient to operate call bells or to even cause fire. This calls for permanent contacts every few blocks between the mains, and each house owner should connect together in the same way his service pipes at a point just inside the wall. Electrolysis prevention is a difficult problem and cannot be secured, as so many railway men claim, by merely running copper wire from a water pipe to the dynamo.

"METALLIC" INSULATORS FOR THIRD RAIL AND CONDUIT CONDUCTORS.

THE third rail is rapidly coming to the front as a working conductor for electric railroads, and bids fair in time to supplant entirely the overhead trolley for suburban and interurban traffic. Placed so close to the ground the rail is specially subject to insulating strains, while at the same time it is exposed to mechanical strains which overhead conductors are not called upon to stand. A third rail insulator therefor for good service requires an insulation strong both electrically and mechanically.

To meet these requirements the Metallic Insulation Company, of New Brunswick, N. J., has just brought out a third rail insulator, shown in two views in Figs. 1 and 2. This insulator of iron consists of the base, which is attached to the



FIGS. 1, 2 AND 3.—"METALLIC" INSULATORS FOR THIRD RAIL AND CONDUIT CONDUCTORS.

cross-tie and of a petticoat top, to which the conducting rail is fastened by bolts.

The insulator is coated completely with the "metallic" insulation, so-called because it has all the strain-resisting properties of metal, accompanied by high insulating qualities. The insulation, in fact, is an enamel applied at a high heat; it cannot be broken off with the blow of a hammer, forming, as it does, a perfect union with the iron to which it is applied.

These insulators will bear a deflective working strain of more than 10,000 pounds, with compressive and tensile strains in proportion. The insulating material is free from all vegetable material, is impervious to moisture, to all alkalies, and to most destructive acids, so that it is specially adapted to railroad work.

To meet the demand for an insulator for railway conduit work the Metallic Insulation Company have designed the type shown in Fig. 3. This is specially adapted to the present general type of conduit railway construction, and the insulators possess the same general properties of the third-rail insulator described above.

NEW G. E. 57 RAILWAY MOTOR.

In line with the G. E. 52 and G. E. 1,000 railway motors, the General Electric Company announces a third, the G. E. 57. This is called forth by the success and popularity of the G. E. 1,000, to which it is similar in design, but of greater capacity, while still as compact and simple. It is intended for heavy city and suburban work and is suitable for service of that class either as a two or four-motor equipment.

The G. E. 57 has an output of 50 h. p. at 500 volts rated according to standard General Electric basis—a maximum rise of 75 deg. C. in the temperature of the windings after a run of one hour at rated load, the temperature of the surrounding air not exceeding 25 deg. C.

The frame is of similar construction to that of the G. E. 52 motor. It is steel, cast in two bowl-shaped pieces, with a hand hole in the lower half directly beneath the commutator. This permits free access to the bottom of the motor for inspection or cleaning. The frame is both water and dust proof, the cover plate of the top half being provided with a felt gasket and clamping bolts, as in the G. E. 1,000 motor. The motor has four laminated poles, each having a separate coil held in place by the pole piece, which is bolted to the frame, the bolts projecting through the frame, with nut and lock washer on the outside.

Knowing the amount of trouble that has been experienced by street railway companies from small motor bearings and their poor lubricataion, the bearings of this motor have been designed with special reference to these points. The armature bearings are of the following dimensions: Pinion end, 3¼-inch by 8¾-inch; commutator end, 2⅞-inch by 6⅝-inch. They are designed and built on the "outboard" plan.

Either oil or grease may be used in the bearings. The lower boxes, or oil wells, are provided with felt wicks, which wipe the shaft through holes cut in the linings. For the armature bearings there are two of these wicks on the pinion end and one on the commutator end. For each of the axle bearings there are two wicks.

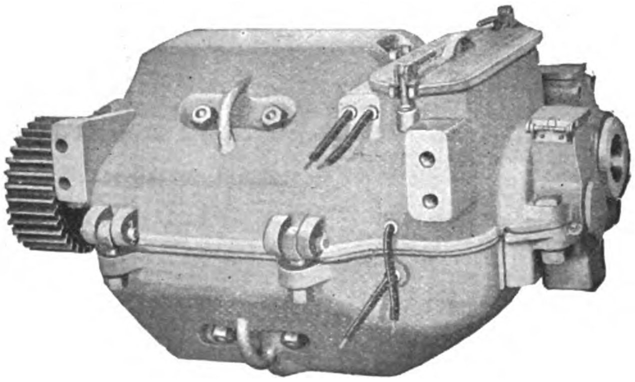
The field coils are wound on cast spools thoroughly insulated with asbestos, mica and paper and wound with copper ribbon insulated with asbestos. A covering of heavy duck drawn together and sewed after the spool has been wound forms a perfect mechanical protection for the winding. As in the G. E. 1,000 motor, the upper and lower field connection is made on the outside of the motor, and all leads to the car are brought out on the front end. This has been found convenient in the car wiring and opening of the motors.

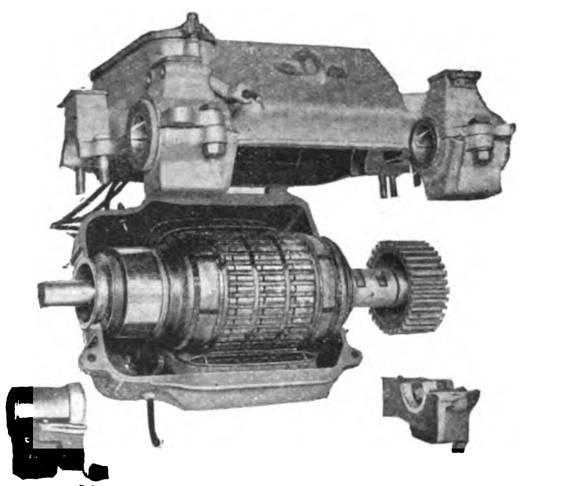
The armature is similar in construction to the G. E. 52 armature. It is small and compact, being 14 inches in diameter, with a spread of 12 inches, and has 33 slots. It is ironclad, the core being built up of well annealed laminated disks assembled directly on the armature shaft. In assembling the core three sets of spacing blocks are used, providing three ventilating ducts. This form of construction is similar to that of the G. E. large generator armatures. There are 33 triple coils, each coil composed of three separate coils, bound into a compact single unit. The separate coils are wound with either two or three turns per coil, as may be specified, the three-turn winding being standard for ordinary service.

This method of winding is a distinct advantage in the matter of armature repairs, there being comparatively few coils to look after, while the construction admits of a substantial insulation of high quality, insuring immunity from repairs. A special effort has been made in the design of this motor to have the armature as light as possible without detracting from its electrical merit and efficiency, a light armature having small inertia presenting special advantages in starting and braking.

The standard gear ratio is 3.72, with a taper bore pinion having 18 teeth, and a cast steel gear having 67 teeth, and a face of 5 inches. A 2-motor equipment, with this ratio will propel an 18-ton car about 26 miles per hour on level track. For heavy haulage work a lower speed gear ratio may be used, giving a slower speed and correspondingly increased tractive effort. A higher speed gear ratio may also be used, giving an increased speed and correspondingly decreased tractive effort.

The commutator is similar in construction to the G. E. 1,000 and has 99 segments. The segments are of hard drawn copper, 2 inches deep, allowing a wearing depth of 1 inch. The brush holders are staggered to prevent the wearing of ridges in the commutator, and each holder contains two radial brushes 2¼ inches long by 1¾ inches wide by ⅝ of an inch thick.





FIGS. 1 AND 2.—NEW G. E. 57 RAILWAY MOTOR.

The standard G. E. 57 motor is adapted to either the nose or the yoke suspension, as in the G. E. 1,000 or the G. E. 52 motor. The motor can be fitted for side-bar suspension, but this necessitates a slight modification of the frame. The yoke suspension is recommended, as with this suspension the weight of the motor is carried on springs placed on the side frames of the car trucks. Lugs are cast on the upper half of the motor frame, to which the suspension bar is bolted. For inspection or repairs, the lower half of the motor can be swung down into the pit without disturbing the upper half. When the motor is mounted on 33-inch wheels the clearance between the bottom of the motor and the top of the track rail is 3¼ inches. The clearance between the bottom of the gear case for 57-tooth axle gear and the top of the track rail is 4⅛ inches.

The G. E. 57 motor without gear or gear case weighs 2,632 pounds. With 67-tooth gear and gear case the weight of the motor complete is 2,972 pounds.

The accompanying engraving, Fig. 1, shows the front end of the motor, and Fig. 2 shows the lower frame dropped with armature ready for removal.

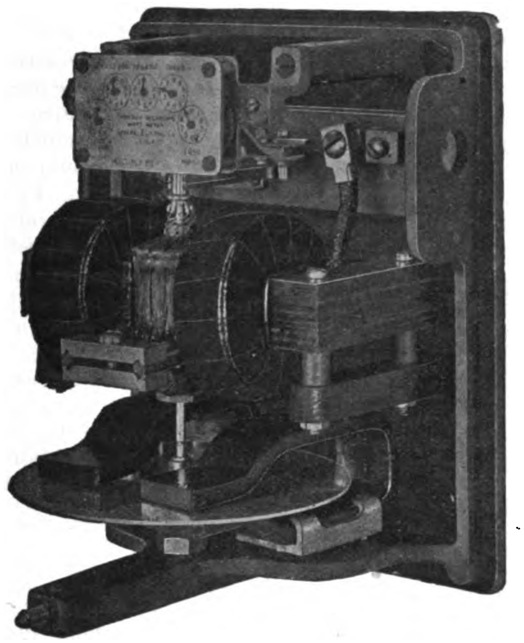
THOMSON RECORDING WATTMETERS FOR STREET CARS.

The advantage of exact measurement of station output has long been recognized, and the requisite meters provided, but to record the ever varying energy used on a car traveling over all conditions of road, involves difficulties almost insurmountable. In the Thomson recording wattmeter for street railway service, however, the General Electric Company claim to have overcome all the obstacles. The new meter which has been placed on the market after a number of years of experimental work, is intended for installation in the

car, like a cash register. It records the actual energy used by the car. A few trials determine the proper energy consumption per car per trip under various conditions of track and traffic. Subsequent readings of the meter determine at once if energy is carelessly wasted, and thus serve as an effectual check on the motorman and condition of the motors.

Many railway managers agree that the average waste due to carelessness of the motorman amounts to not less than 20 per cent. of all the energy generated. The economy, therefore, which will be induced by the use of street car meters will mean a saving of half of the average waste, or 10 per cent. of the total energy generated.

The simple motor construction of the car meter, as shown in



THOMSON RECORDING WATTMETER FOR STREET CARS.

the accompanying illustration, is similar to that of the other forms of Thomson recording wattmeter, but new conditions imposed by the rough service have been met by the careful design of the rotating parts. Unavoidable vibration, due to rough tracks, demands a low drop in the armature in order that contacts may not be injured by sparking. High torque is also a requirement, so that heavy brush pressure insuring perfect contact can be used. The sudden and wide variation of current requires a meter that will start quickly and slow down as soon as the current diminishes. The General Electric Company claims high accuracy for its new meter and ability to withstand severe and continued use on the roughest tracks. The meter is now made for 500 volt circuits in sizes for 25 or 50 amperes, with a liberal provision for overloading.

LETTERS TO THE EDITOR

THE IDENTITY OF PRIVATE OWNERSHIP ADVOCATES.

I have read the article of Mr. Albert E. Winchester, Electric Light Company, of South Norwalk, Conn., in your issue of September 2, 1897. On page 215 of that issue Mr. Winchester states the following: "I do not consider myself qualified to advance extreme ideas for or against municipal or private plants, as my interests are with both, so long as either is conducted as public satisfying institutions; as to financial results and management I believe the two systems stand about even and my sympathies are drawn to the municipal side of the question only for the reason that I detest the injustice that has been so freely resorted to by those interested in private plants, whose agents have too often, as this man Francisco has done, cast honor to the winds, not hesitating to call to their aid lies and slanderous assumptions in the place of facts, which they dared not use, greedily grasping at isolated instances of mismanagement of municipal plants, which they have magnified out of all proportions, forgetting that such instances occur with equal frequency in privately owned plants."

Also in the issue of The Electrical Engineer of September 30, page 311, Mr. Winchester says the following:

"It will always be my pleasure, as it has been in the past, to return courtesy for courtesy to those who desire such information as I am able to give."

Acting upon this last statement of Mr. Winchester's, I will ask him to please give me the name or names of those interested in these private plants he speaks of in his first article, or the names of the agents he mentions, that "have not hesitated to call to their aid lies and slanderous assumptions in the place of facts, etc.," that I may know what managers or agents of private corporations are acting in this outrageous manner. I am personally acquainted with a large number of managers and this is the first time that I have had an intimation of such actions. The names can be published in your journal or sent to me personally.

W. WORTH BEAN.

St. Joseph, Mich., Oct. 7, 1897.

THE ACTION OF THE BRUSH MULTI-CIRCUIT ARC MACHINE.

MR. SAMUEL W. RUSHMORE, in a letter concerning Brush arc dynamos, which appears in your issue of September 23, 1897, page 283, makes a number of statements which indicate that he is not very familiar with the theory or practice of the Brush multi-circuit dynamos. In the second paragraph of Mr. Rushmore's letter he makes the following statement:

"From the above, it would seem that you considered the Brush machine capable of supplying several independent circuits, but it is not."

In the third paragraph of the same letter we find the following statement:

"If the circuit is accidentally broken, or if the machine flashes, as it frequently does, the lamps all drop their carbons and the whole voltage of the three 2,500-volt circuits, or 7,500 volts, to which is added the heavy discharge of the field coils, is piled up in a single discharge, and at such times, the strain on the insulation and risk of life is fully as great as if the machine were supplying a single circuit of 150 lamps."

Instead of being an element of danger, flashing at the commutator on the Brush machine is a safeguard, because such flashing shunts the armature by low resistance arcs at the commutator, with the result that the voltage at the terminals immediately falls. The high voltage discharge from the field is entirely prevented in the Brush machine, because the field coils are wound upon heavy brass spools, and are also at all times shunted by a non-inductive shunt. As is well known in the art, a coil so shunted cannot produce a high potential discharge.

This same action also prevents an injurious rise of potential, upon rupture of a circuit, while interruption of service, in the case of a rupture of a circuit, can be prevented by means of a cutout, which short-circuits at the station any line which may by accident become open-circuited.

While it is true that the two or more circuits operated by Brush multi-circuit machines may be considered as one electrical circuit, they are, for all practical purposes, independent, as the number of lamps in each circuit can be regulated independently without effect on the remaining circuits; and for reasons which have just been explained, the potential or pressure on each circuit is limited and cannot rise to any such dangerous proportions as Mr. Rushmore carelessly, or ignorantly, assumes.

The simplicity and economy of operation, which result from the Brush multi-circuit method, are obvious, and have appealed so powerfully to station managers, that many such machines are now in operation, and, judging from the orders which are now being received, many of which are "repeat" orders, it is evident that the practical results are entirely satisfactory to the progressive and enlightened electric lighting manager and engineer.

Lynn, Mass. C. M. GREEN.

LONGEVITY OF LINE WIRE.

I notice a letter in your paper of Sept. 23 from O. B. inquiring about life of line wire. In reply I will say, we have been operating the Heisler system for the past eight years, and we have about five miles of commercial circuit of No. 8 wire that has been up since we started. It hardly shows any wear of insulation. It is what was called "Shield Brand" at the time we purchased it. We have about six miles of street circuit that we are now replacing mostly on account of lines running through shade trees.

SAMUEL WILKINSON,
Electrician for Globe Furniture Co.

Northville, Mich., Oct. 4, 1897.

THE

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FROM NEW YORK TO PHILADELPHIA IN 36 MINUTES.

HIGH speed electric railway projects have been mooted from time to time and several interesting plans have been worked out. The first of the kind to attract general attention was one by Mr. O. T. Crosby, who read an exhaustive paper on the subject before the American Institute of Electrical Engineers in 1891. Later Mr. Frank J. Sprague, before the same society, in his inaugural address in 1892, took as his problem the electrical connection of the cities of New York and Philadelphia. In this project Mr. Sprague adopted as a basis for calculation a speed of 60 miles per hour between the two terminal points. The discussion of a project to accomplish the same distance in 36 minutes, or at an average speed of 141⅔ miles per hour forms the subject of a highly interesting essay by Messrs. Charles H. Davis and F. Stuart Williamson in the "Engineering Magazine" for October. In the portion of this essay which has thus far appeared the authors confine themselves to the discussion of the engineering problems, reserving for a later chapter the calculation of the cost of such an enterprise. It goes without saying that a road operated at such high speed must have no grade crossings, and that a rigid roadbed alone would be permissible. Coming down to details, the authors advocate the adoption of a rail 9 to 12 inches deep, weighing about 250 pounds to the yard, each rail being 60 feet long, and resting on braced steel chairs, with metal ties laid two feet on centers and carrying four rails. To reduce oscillation, one rail could be slightly elevated the entire length of the line, which would reduce the train resistance, as well as conduce to the comfort of the passengers. Very few curves, the sharpest having a 4-mile radius, would permit of material reduction in train resistance.

As regards the electric details the third rail is considered the only feasible method of contact. This rail is to be placed close beside the car, elevated about two feet above the rails, and supported on ties as permanently and substantially as the other rails. The same structure carrying the third rails would also carry the feeders, while the high tension transmission lines would be placed on poles alongside the track. The authors anticipate no great difficulty in gathering the current by means of contact shoes, even at that high speed.

The speed adopted naturally makes the question of train signaling of the highest importance, and in some respects the most difficult to solve. One can well imagine that on a road operating at 170 miles an hour maximum, or at the rate of 2.853 miles per minute, a signal system must be perfection itself, almost divinely perfect in its functions. It would take us too far to go into the details which have been worked out tentatively, though very neatly, by the authors. Suffice it to say that the section upon which a train is running and the one immediately ahead always have current, while the two sections following a train are always dead; there are also three danger signals behind every train. The interlocking signals would also be connected to the conductors so that they would be deprived of current should the motorman be neglectful of his duty. They would also include devices for automatically applying the brakes. As to the constructive details of feeders and ground returns, they would follow existing practice.

Coming to the number and location of power stations, Messrs. Davis and Williamson assume the necessity of five such stations, a number which is somewhat in excess of the estimates of others who have considered the project. Two of these stations would be 6½ miles from each terminal or point of maximum acceleration, while the others would be spaced 18 miles apart. The passenger cars—there would, of course, be no freight handled on such a road—would be designed to rest on six-wheel trucks, with wheels seven feet in diameter. They would have a seating capacity for 140 passengers, and such a car, it is estimated, could be brought to a stop within 9,910 feet on a level track. As to the actual train resistance which would be encountered, the authors conclude that the existing formulas are not sufficiently reliable for safe application to the present case, but they are of the opinion that it would be much less than many engineers now believe. To effect the necessary acceleration at starting, they calculate will require 1,450 h. p. per car, and it would require six minutes to attain full speed on a level!

These are most interesting figures. Indeed, the essay is worked out in excellent detail and we are somewhat curious to know how the financial side of the problem will show up.

Writing on a somewhat analogous subject, in the same number of the "Engineering Magazine" Prof. George Forbes discusses the application of electric power on trunk lines. Prof. Forbes seems to regard the City and South London Railway as the prototype or rather forerunner of electric trunk line traffic. We are not disposed to quarrel with Prof. Forbes on this score, even though that road was the first to adopt electric locomotives. For, as a matter of fact, all indications point to the adoption of a motor car as the propelling unit, or, indeed, of individual car units which Mr. Sprague has consistently advocated from the start. That would be coming right down to the present tramway practice; and that, indeed, is what trunk line service may come to, that is, individual cars running on short headway. Prof. Forbes urges very strongly the utilization of water power for electric railway work, asserting that where it is available it would be generally economical to transmit electric power hundreds of miles for working railways. He goes so far even as to maintain that it can be proved that the whole of the railways of Scotland could be operated from existing water powers without the use of steam locomotives. We hope the suggestions will not be lost on the Scotch railway directors, who are looking very sharply after the "baubies."

Prof. Forbes also indulges in a little criticism of cis-Atlantic electric railroad practices. Thus, he thinks, that the Niagara Falls Park and Railway, on the Canadian side—a 12-mile road—ought to have been run entirely by water power instead of steam at one end and water power in the middle. He thinks that high tension transmission should also have been used to replace the steam plant referred to. The builders of that road employed some pretty good engineers, and we would like to hear their side of the story before passing judgment. Besides, that road is now an old story, on this side of the water.

Another criticism vouchsafed by Prof. Forbes is that the efficiency of dynamos and motors has not been sufficiently considered in street railway practice in the United States. This may have been true in the early days, but we are afraid that Prof. Forbes was too much engaged studying the habits of American millionaires on his last visit here to pay much attention to street railroading; at any rate, we would like to see proofs of the assertion as applied to later American street railway work. Prof. Forbes also informs us that it was he who suggested mounting the motor on wheels or axles of cars, and foretold all the benefits of electric traction as far back as 1879. How strange this must read to many who possess patents on some of these features. Prof. Forbes is a strong advocate of high tension transmission for railroads in conjunction with rotary transformers. But, unfortunately, according to him, the rotary transformer is expensive, cumbrous and requires continual attention; this last fact renders it impossible to lay such machines along a trunk line. But we breathe freely

again on reading further and learning that Prof. Forbes has prepared designs for a device free from all the defects referred to, which can be manufactured at small cost. For years, Prof. Forbes tells us, he has impressed upon manufacturers the desirability of such a machine, and that it will be only a matter of time when they will find that it is to their own interest to provide it. It is a pity Prof. Forbes has hidden his light under a bushel all this time. What is this device which shall replace the rotary transformer? And if it is so greatly superior, why is it not employed in connection with the work at Niagara? Or may it be that these barbarisms were introduced after Prof. Forbes left Niagara to its fate? It will thus be seen that electric railroading has much, and will have more for which to thank Prof. Forbes.

Barring these little bits of egotism, Prof. Forbes' article is suggestive in several directions, more especially in his advocacy of electric railroads in desert regions and in its almost chauvinistic favoring of water power transmission.

TAGGING WIRES.

An act was passed in Massachusetts in 1890 for the supervision and regulation of overhead wires in cities, and a special act met the necessities of the case in Boston in 1894. The law made it obligatory for cities to appoint inspectors of wires whose duty it was to enforce the law of 1890, but until a few months ago the provisions were not rigidly enforced in all the cities. Some of the authorities thought they had done all that was required when they appointed inspectors, several of whom held other positions and received no extra compensation. An accident occurred, however, at Chelsea, recently, which has had the result of directing public attention to the matter and of stirring up considerable activity. A broken telephone wire hung down to the ground, crossing a high potential electric light wire, and through contact with it two men lost their lives. The inspector of wires, after an examination, was indicted for manslaughter, and his case comes before a jury at the next term of court. The wire was not tagged, but we fail to see how tagging it would have prevented the breakage.

At any rate, the incident has stirred up the inspectors, we note by the newspapers, all over the State, and at the present time the circuits are pretty well tagged up, at least 100 different styles of tags being in use. They are generally made of flat metal, about an inch across, stamped with the name or initial of the operating company, and are usually fastened near the insulator. In Boston, where a company owns a line of poles or fixtures, and uses it alone and exclusively, each wire is not tagged, but the company's name is stencilled on the cross-arm. But where two parties operate together on the same wire structures, each line must be tagged.

While it is plain that tagging will not prevent wires from breaking, it is also plain that such a system has many advantages and must be of great benefit not alone to the inspectors, but to workmen on the lines, whether overhead or underground. Our readers are probably familiar, like ourselves, with cases in which funny or serious mistakes have been made in cutting into the wrong circuits. Moreover, there is a class of people in many communities who will sneak on other persons' poles and fixtures without leave or license, and fasten up their wires in anything but a safe and substantial manner. When such wires are found, for example, by the Boston Wire Department, of which Capt. W. Brophy is chief electrician, they are treated as dead wires and cut down. This naturally brings the owner to the office, to know why his wires were cut down, when he learns many things he did not know before. To this kind of "sneak wire" many of the accidents from crosses with high potential wires must doubtless be attributed.

It might be thought that these tags give an untidy appearance to the wire, but it is not so, as being of metal they do not flutter in the wind. Each company also has an incentive to keep up its wires in better condition, the ownership being so publicly avowed. Neither do the tags blow off nor cut into the insulation. In fact, the New England experience appears to be in favor of the system, and the tags are recommended by the officials not only for overhead circuits, but in subways and manholes.

THE NEW SPRAGUE COMPANY.

We publish elsewhere in this issue the news relative to the formation this week of the new Sprague Electric Co., with a capital stock of $5,000,000. This corporation will not only manufacture the electric elevators which Mr. F. J. Sprague has made so successful, but the other inventions to which that well-known engineer has more latterly been giving attention in the railway field. In addition it will carry on the manufacture of the many specialties which the Interior Conduit & Insulation Co. has made standard and universal during the past seven or eight years. Taking electrical development where it stood at the time of the formation of the General Electric Co., Mr. E. H. Johnson may be said to have now brought together complete systems for lighting, power and railway work, whose creation dates entirely from that memorable period, and none can gainsay the great value of the inventions and properties thus massed together. The personnel of the new organization, with Mr. A. B. Chandler at its head, is also remarkable. That gentleman inspires respect and confidence in whatever he does, and with him are men who for daring and genius are unsurpassed in this country. The new enterprise will have hearty wishes everywhere for its abundant success. Particularly significant at this juncture is Mr. Sprague's definite return to the railway field in which, as a pioneer, he made so deep a record, and once again he may be expected to give the art a new date of departure. To-day, even more than when his Richmond road was started, are there difficult problems awaiting solution, and of Mr. Sprague's resolve to deal with them an earnest is now given.

THE PHILADELPHIA GAS LEASE.

We note that the Committee of Councils in Philadelphia has voted by 12 against 3 in favor of the lease of the city gas works; whence it may be inferred that the offer of the United Gas Improvement Co. will be accepted and the plant soon transferred to private hands. It is to be hoped that such a change will be made shortly, for all the reports made on the subject have been sharply adverse to the further control of gas making by the city. "The Engineering News," of this city, in discussing the question, and quoting recent utterances in these pages on the subject, says: "We regret that our contemporary's violent prejudice against municipal ownership in general should cause it to so misstate the facts and mislead its readers." This is rather too much. Not a single figure or statement has been made in these pages which was not taken directly and exactly from the official reports of the city authorities, or other local officials. Nobody has disproved their reports, and we fail to see why any accusation of unfairness should lie against us. We are also inclined to object to the phrase, "violent prejudice." It is hardly courteous, to say the least. We confess to a very strong conviction that the present tendency to have government do everything is all wrong, and that most progress is made when the sphere of government ownership and legislative control is severely restricted; and we think the evidence in the case supports us. Our contemporary's own vigorous article in the same issue on the "dry rot methods of the Bureau of Docks and Yards," is but one more proof added to innumerable others, that a government, whether national, state or municipal, had better let alone commercial, industrial and manufacturing business of any kind and every kind.

HOW LONG IS A CARBON STICK?

Mark Twain in his new book tells how, being limited to one cigar a day, that cigar soon grew to Brobdignagian proportions. In like manner, it would seem, the carbon importers, being subjected to a duty of 90c. per 100 without limit as to size, have been bringing in carbons two or three feet long. The Customs authorities object, but if so, then these carbon sticks would, it seems, be dutiable only at 35 per cent. ad valorem, as miscellaneous and unenumerated. The duty as it stands is absurd and involves no question of protection, because while it discriminates wildly in one direction against imported arc light carbons, if it be so enforced, on the other hand it discriminates very foolishly in favor of imported carbons of any greater bulk, used in search lights or for furnace purposes. Until a rational duty on a fair basis is reached, we must confess that our sympathies run towards carbons fifteen feet long. As the advance of the now very prosperous enclosed arc industry depends on a prompt and reasonable settlement of this dispute, we trust a sensible and fair conclusion may soon be reached, even if it require new legislation.

ELECTRIC LIGHTING

ARC LAMPS AND THEIR MECHANISM.—III.

(Concluded.)

BY H. FRANKLIN WATTS.

IN the employment of insulating bushings and washers, one cannot fail to wonder at the flimsiness of the insulation used in many lamps. A certain maker uses a fiber washer ¼-inch in diameter, with a 1-32 hole in the center, through which passes a 12-36 screw, and this is intended to insulate 50 volts. Another uses a countersunk screw insulated by a wooden bushing and separating it from its surrounding iron by 1-32-inch all around. It is hardly necessary to add that but a small accumulation of dirt will easily bridge these short spaces and ground the lamp with the frame. Especially is this true around railroads, where the presence of cinders is a prolific source of trouble in this respect.

In the Thomson-Houston lamp the screws that connect the side rods to the lamp box are insulated from the latter by hard rubber bushings, which are underneath, the screws passing up and through them into the lamp box. Probably a dozen makes are the same thing. It is to be observed that the insulating bushing, upon which much depends, is exposed to the weather and in the path of water, which will run down the side rods in rainy weather, while the other end of the screw, which is perfectly dead, is carefully housed in the covers of the lamp. A much better arrangement would be to reverse the entire order of things by putting the screws down from above, thus bringing the bushings inside the lamp box and having the dead screw ends exposed to the weather.

To insulate the lower holders and dust pan, if you have one, is not so easy, as some dust pans seem intended to hold half an inch of conducting carbon dust and water, which, as soon as it is full, runs down all over the insulation. In such cases the dust pan had better be dispensed with and a large vulcabeston or micanite bushing be used in the center to give the best results. Wherever it is necessary to use a bushing or washer, make them large and heavy in place of so many "invisible" and entirely inadequate ones.

When used to light up freight yards, depots and round houses I have found that 9 out of every 10 lamps of standard make will be grounded on the frame when tested with a 1,000-volt alternating current, due to the presence of cinders which sift in under the covers, leaving a conducting deposit upon the entire mechanism. The amount of dust that will get into a lamp hung in a foundry is astonishing. Mr. W. H. Markland, the electrician to the Pennsylvania Railroad, says that he "once packed the covers of a lamp with rubber gaskets, as one would a steam chest, and at the end of three months found one-fourth inch of dust in it."

An excellent way of testing the insulation of arc lamps is with a 1,000-volt current obtained by using two 5-light transformers with their secondaries connected together with five lamps in series, the primary of one being connected to the line and the other to the testing cords.

A 1,000-volt current being in one primary, there are also 1,000 volts in the testing cords. This current, while being of sufficient voltage for testing purposes, will not burn anything by arcing—the amperes being too small. Neither is there any danger of short circuit on account of the five lamps which limit the current. The entire primary current can be carried by shunt winding of the lamp. It is, therefore, an ideal arrangement for testing insulation.

The present tendency is to make all out-door lamps waterproof and to dispense with the hood altogether, bringing the wire direct to the lamp terminals. Even Noah's Ark was thoroughly waterproof and successfully stood the tempest for [illegible] days, at the end of which time, owing, perhaps, to Jersey lightning, the Ark became heavily grounded.

Perhaps the severest service to which a lamp is often put is to do duty over some of the cinder pits of the railroad companies where locomotive smoke boxes and fire boxes are cleaned, ashes removed and water thrown out of the cylinders by suddenly giving the engine steam, causing it to slip its wheels. Here not only is ejected water, but usually a goodly quantity of cylinder oil and indelible soot keeps company with it. A moment later the program will be varied by an engine blowing off furiously and covering our unhappy lamp, rods, globe and all, with a cold perspiration. The lamp is thus placed in readiness for the third act, which consists in turning on the steam blower, which is virtually a young volcano of black smoke, dry cinders and gases. All of this the lamp on the pole gets the benefit of, and it is not long before the globe is opaque to anything short of an X-ray. In round houses, too, the service is severe on copper and brass on account of the sulphurous gases there present.

I have seen ¾-inch rods eaten completely through by the products of combustion which escape from the smoky throats of a score or more of engines. In such cases I believe the use of coal oil upon the rods of the lamps to be particularly advantageous. Many lamps have a "change over" or a "transfer" device, usually a tilting lever, so arranged that the second pair of carbons are brought into action as soon as the first side is entirely consumed. The result of this is that if for any reason the first side fails to feed, the lamp will go out. The experience of the last few years has repeatedly demonstrated that all such devices are worse than useless, and that it is infinitely better for a lamp to "change over" continually than to go out altogether. The changing over function can be performed much better by adjusting each side to burn at different positions of the armature.

The tendency to burn higher on the second side can be easily offset by the weight of the rod, which, when down, rests entirely upon the armature, nearer or further from the pivot according to the requirements of each case. Notwithstanding this, and many other precautions, the fact remains that most lamps do burn higher on the second side, due to dirt and stickiness of the parts. It would, therefore, seem to be a good idea to adjust all new lamps to burn lower on the second side to counteract the effects of dirt, etc. The majority of lamps of the ordinary type have the negative wire from the carbons attached to one of the side rods by small wire bands. Great care seems to be taken that this wire should be on the side of the rod nearest the arc and as near to it as possible. The heat of the arc soon tells upon the insulation on the wire and sooner or later it becomes carbonized, the wire is bare, and the wire band connects it with one of the side rods. There seems to be no reason why this wire cannot be placed on the back of the side rod away from the arc, and thus be protected from its effects.

The recent activity in enclosed arcs, indicates the tendency of the times and scarcely a week passes that does not record the exploitation of a lew lamp of this type. If the inner globe becomes opaque by carbon deposits at the end of 50 hours, as seems to be the case in most lamps, then evidently there is no advantage in attempting to make a lamp burn longer than that time, since it must then be cleaned, and in cleaning it one may as well trim it. The lamp seems to depend upon the use of a carbon of the greatest purity. The possibilities are very great and good progress has already been made. One thing is certain; the enclosed arc has come to stay and the greatest development in lamps in the near future will surely be in this direction. When dynamos are built capable of maintaining 5 or 10 independent circuits of 100 lamps each, and lamps, while hanging in our streets, can be made to burn 150 or 200 hours without diminution of candle power and will repeatedly start pointed carbons to a certainty, then, indeed, may we well be proud of this, our latest and grandest achievement in the realm of electric arc lighting.

Retracing our steps to the starting point, we may now reconsider some of the principal points noticed and in the order of their importance.

1. See that your lamp has a good cutout if it has nothing else, using pure silver only for the contacts.

2. Let all improvements consist in doing away with parts.

3. Use good and sufficient insulating materials, combined with workmanship, and, if possible, connect the inner end of series coil to magnet frames.

4. Eliminate all possible friction between the rods and their bushings by the use of anti-friction material.

5. Use a sliding contact which has stood the test of years, combining it with rod bushings, if possible.

6. Use a clutch having a large wearing surface sufficient to last for years, regardless of its "sneak feed" propensities.

7. Let gravity take the place of all springs, and the weight of the parts constitute all adjustments.

8. Use insulating bushings and washers of large size, placing them all inside the lamp covers, especially those insulating upper from lower frame.

9. Dispense with all "change over" or "transfer" devices and adjust second pair of carbons to burn 3 volts lower than the first side.

10. Improve the magnetic circuits by reducing the reluctance and raising the permeability.

ELECTRIC RAILWAY CURRENT FOR PRIVATE POWER PURPOSES.

BY CHARLES BUELL.

FROM the Atlantic to the Pacific the United States are strung with thousands of miles of electric railroad circuits that the fire underwriters say cannot be tapped for power purposes. Through many of the streets of the cities that have electrical railroad circuits there are power circuits from which electricity for power purposes can be obtained, but through many parts of these cities no regular power circuits run and through these same parts are strung the electric railroad wires.

It is a common thing for persons along these railroad circuits that have not access to power circuits to want a small amount of power to run some small machinery. The first thing that comes into their minds is the electric motor and electricity from the railroad wire that passes by their door, but on investigation they are informed that the fire underwriters will not permit the use of this current in their buildings.

Some go to the trouble of building a small sheet-iron house a short distance from the building in which the power is to be used. In the sheet-iron house the motor is installed and power is transmitted into the larger building by a shaft or belt of some kind. There are many places where the vacant spot for the motor house can be obtained and in any event it is quite an expense to erect it.

There is another bad feature about having the motor in a separate building, and that is, a person is compelled to pass out of doors and into the small building to start the motor, or have a complicated arrangement of some kind for starting.

One of the first things that is asked, when some one finds that he is thus debarred, is, why such conditions exist. This is a pretty hard question to answer and the supposition is that the railroad current is deemed dangerous.

By many people it is accepted as true that current from a railroad circuit is more dangerous from fire than current from a 500 volt power circuit. Before the fire underwriters forbade the use of railroad current or current from a 500 volt circuit, using the ground for one side of the circuit, to be used in operating electric motors, the writer had installed quite a number of electric motors on railroad circuits and watched very closely their behavior. There never came up any trouble, save once, that might not occur on a metallic circuit. There was a 10 horse power motor driving a printing office; it had been running for months with marked smoothness, but all of a sudden it acted very strangely. It would stop running when apparently everything was all right and if the switch was closed it would start without any notice being given. The trouble was traced to the wire running to the rail, which had become loosened; one car passing would break the circuit and the next might close it. On properly connecting the ground wire to the rail there was no more trouble.

The writer has had an extended experience with electric motors and if he were to have one of 25 horse power installed he would rather have the current from a circuit using the ground for one leg, than one using a metallic circuit, all other things being equal, and voltage not over 600, for the following reasons: First, if the motor be of 25 horse power it should be placed on a stone or brick foundation topped off with wood or some better insulating material. The distance from the metal work of the motor to the ground would be so small that it would be an easy path for atmospheric current; hence during a thunder storm the insulation would be apt to be punctured unless there were good lightning arresters on all legs of wire leading from the pole line to the motor. Good lightning arresters are expensive and want good care to keep them in repair. Our advice then would be to plan our work to use just as few lightning arresters as possible.

With one leg of the motor circuit going directly to the ground but one good arrester is needed, where, with the metallic circuit, two would have to be used.

Second, there is the question of getting a cross on a gas or water pipe, when plumbers and gas fitters are working after the wiring is done. If this occurs on a metallic circuit, during a thunder storm the insulation is apt to be broken down and then in future wet seasons current is apt to cross from the wire to the ground through the pipe. Since it is from a metallic circuit it is apt to be small and not sufficiently large to blow the fuse; such things occur and remain for long periods and sometimes burn holes in the pipes, letting the water or gas escape.

The writer knows of such a case happening in Scranton, where the gas pipe was punctured, between ceiling and floor: the gas lighted and it burned for some time before the trouble was discovered. It was detected from the floor being warm.

On a circuit with one leg in the ground this cannot occur. If the leg from the pole line gets crossed on a pipe or something similar, out goes the fuse and it will keep going out until the cross is removed. The argument is put forward by the underwriters that the grounded circuit is more apt to give a person a shock when standing on the ground or a wet place, but the writer has never found any trouble in getting a shock from a 500 volt power circuit by standing on the wet ground and touching either side of the live circuit.

ELECTRICAL POWER DEVELOPMENT ON THE APPLE RIVER, WIS.

APPLE RIVER is one of the most interesting water powers in the northwestern country, the stream having a minimum flow of over 22,000 cubic feet per minute, and it is now proposed to develop it for the benefit of New Richmond and other places nearby. The Apple River Power Company was organized in June last with $50,000 capital stock, and after a careful survey of the river for 25 miles, the company decided to locate its power plant at Somerset, a village 7 1-10 miles from New Richmond. Mr. F. W. Epley is the president and general manager.

Plans for a dam and raceway with 21 foot head were made by Mr. C. B. Pride, of Appleton, Wis., and the contract let to Rob. A. Lane, of Eau Claire, Wis., to construct the work. It is now nearing completion. The power thus developed will be partially taken up by a pair of 42-inch New American special turbine water wheels set horizontally, and transmitted by belt direct to a 250 kilowatt inductor type generator made by the Westinghouse Electric and Manufacturing Company. Thence with an initial voltage of 6,000 volts current will be sent over three No. 5 bare copper wires set in triangle and insulated by No. 2 Imperial porcelain insulators, furnished by C. K. Knowles, of Boston, Mass., to New Richmond. There it will be reduced to a voltage of 200 by means of step-down oil transformers and distributed about the city. The company have long term contracts with the city and roller mills for 100 horse-power each and others pending the completion of the plant. The flume is constructed with two compartments, and provision has been made for another pair of 42-inch wheels, which will consume the flow of the river except in the very dryest seasons when these will be run at part gate. But for 11 months in the year there is ample water for the four wheels. As more power is needed, the second pair of wheels and another generator will be installed, provision having been made in the power house for two generators of equal capacity. The company own and will operate at Somerset a custom flour and feed mill which will be run in connection with the transmission of power.

Apple River is formed by 21 large lakes and is only about 30 miles long, so that the flow of water is very constant.

New Richmond is a bustling city of 2,000 inhabitants, and the current there will be fed right into the lines of an old three-wire direct current Edison plant. The city water supply comes from an artesian well, delivering 600 gallons per minute at the top of an 8-inch drill hole in the rock upon which rests a 750,000 gallon Smith-Vaile pump, which pumps directly into a 100-foot stand pipe, and will soon be supplemented by a Quimby screw pump of the same capacity. New Richmond Roller Mills, taking the electric power, have a capacity of 300 barrels, running day and night; and the Northern Grain Company have an elevator and feed mill of half the capacity of the flour mill. Other industries requiring power are a wool carding mill, wood novelty factory, machine shop, two grain elevators, etc. It is believed that the plant will be the best illustration of power transmission of its size in the Northwestern States.

NOVEL POWER TRANSMISSION AT CUERO, TEX.

About 3¼ miles from Cuero, Tex., a stone and concrete dam has been thrown across the Guadalupe River, giving a head of 10 feet and developing a net 700 horse-power. The work is being done by the Buchel Power & Irrigation Company, which has a capital of $50,000, and of which Otto Buchel is president and C. A. Buchel, vice-president. Two 54-inch New American turbines have been purchased and are being installed. It is intended to use a part of the power for elevat-

ing water into a reservoir 60 feet above, for irrigation purposes. About 250 horse-power will be transmitted as current to the city of Cuero for lighting and power purposes. About 1,500 incandescent lights and 100 arcs will be supplied. When last heard from the company had not decided on its electrical apparatus, but invites correspondence.

TELEPHONY AND TELEGRAPHY

TELEPHONIC INCIDENTS IN THE SOUTH.

The Southern Bell Telephone Company records some interesting incidents in its recent work. At Quitman, Ga., a negro was on trial under the charge of having burned the academy building in Quitman. The attorneys in the cse concluded that they wanted the testimony of Sheriff Doss, of Thomasville. Sheriff Doss was in Thomasville, and no trains would pass down before 5 o'clock in the afternoon. And just here the long-distance telephone, for the first time in its history in Georgia, was utilized in taking testimony. Sheriff Doss was called up and asked certain questions to which he promptly replied, and his testimony was admitted as evidence.

Recently a well known Atlanta city official had occasion to visit Southwest Georgia, and night found him at Montezuma. In vain he tried to get sleep at his hotel, but it was no go. There was something wrong, and he could not for the life of him tell what was the matter. He imagined that some of his family were ill, and finally got up and went to the telephone station and called up his wife in Atlanta. She answered him that all were well and happy. After telling her that he could not go to sleep she asked him to wait a moment. Stepping to the nursery, she brought out the baby, who proceeded to cry into the telephone receiver for all he was worth. That was all the old man needed, and he soon found sweet repose with the cries of the infant echoing in his ears.

NEW TELEPHONE COMPANY FOR INDIANAPOLIS.

The National Telephone Company, of Indianapolis, Ind., has been incorporated with a capital stock of $40,000. The incorporators are W. E. English, J. W. Murphy, H. D. Pierce, H. P. Wasson, W. E. Thomas, F. H. Parker, president of the Hide and Leather National Bank, of New York, and P. A. McDonald. De-Has & Muir are the company's attorneys. The company has franchise rights in Anderson and elsewhere, Mr. McDonald says, and intends to take advantage of them. A coalition of all the companies outside the Bell will be attempted for the purpose of giving long distance service.

BELL TELEPHONE OUTPUT.

The Bell Telephone Company reports instrument output for the month ended Sept. 20:

	1897.	1896.	Changes.	
Output	19,198	12,042	Inc.	7,156
Returned	7,105	7,030	Inc.	75
Net	12,093	5,012	Inc.	7,081
December 21 to September 20:				
Output	162,743	148,395	Inc.	14,348
Returned	69,106	68,547	Inc.	559
Net	93,637	79,848	Inc.	13,789
Total outstand	865,926	754,824	Inc.	111,102

GRAND RAPIDS, MICH.—The Citizens' Telephone Company has begun paying 2 per cent. quarterly dividends. It is an "independent" organization, and has about 2,300 subscribers.

NORFOLK, VA., rejoices because it now has long distance telephone connection with the United States over the lines of the American Telephone and Telegraph Company.

CORRY, PA.—The Corry Telephone Company, an independent organizataion, with about 150 subscribers, is fighting the Pennsylvania Railroad because it says it cannot, under its Bell contracts, connect with the system, which uses Keating apparatus. Similar disputes are on elsewhere, and are being pushed to an issue by the independent companies out West.

NEWS AND NOTES

FORMATION OF THE SPRAGUE ELECTRIC CO.—AN IMPORTANT CONSOLIDATION.

FOR some time past, as noted already in The Electrical Engineer, plans have been on foot for the practical consolidation of the Sprague Elevator and Interior Conduit interests. Where so much is involved, it is obvious that considerable time must elapse before all the arrangements necessary can be carried to a successful issue; but we are glad to note this week the virtual accomplishment of what has been proposed, in the incorporation, under the laws of New Jersey, of the Sprague Electric Co. With this corporate title a most important combination of valuable and growing enterprises has been effected, on the initiative of Mr. E. H. Johnson, and with the active support of some of the most influential men in the country. The Sprague Electric Co. will own outright, it is understood, the Sprague elevator inventions and properties, and control the Interior Conduit and Insulation Co., all being under one head and one management. The active officers of the new company are Mr. A. B. Chandler, of the Postal-Telegraph Cable Co., as president; Mr. E. H. Johnson, who will be first vice-president and general manager, and Mr. Frank J. Sprague, who will be second vice-president and technical director. The capital stock, preferred and common, of the new company is $5,000,000, half and half, the preferred paying six per cent. cumulative. At the present time a large proportion of the capital stock will remain in the treasury. Among the stockholders may be mentioned John W. Mackay, J. Pierpont Morgan, John E. Searles, W. M. Crane, Zenas Crane, John A. Roebling's Sons, estate of J. Hood Wright, estate of Theodore Havemeyer, A. B. Chandler, E. H. Johnson and F. J. Sprague. The company will, as far and as rapidly as possible, concentrate its manufacturing facilities at the Sprague Watsessing Works, a splendid new factory with superb modern equipment, representing at least $500,000 cash outlay, and will have its New York headquarters at 253 Broadway. Mr. Robert Lundell, of the Interior Conduit Co., will be the responsible head of the designing and manufacturing department for dynamos, motors, etc., and the products of the factory will be largely of his now well-known apparatus and of his new machines about to come on the market. Mr. C. R. Pratt, whose original ideas have been so effective in screw elevators, will be actively and prominently connected with the mechanical department, and Mr. E. R. Carichoff will be entrusted, as heretofore, with much of the electrical designing connected with elevators and railway work, as Mr. Sprague's assistant in those lines. A number of important departments, each under well-known men, will care for the various branches, commercial and technical, of the new company's business.

In importance, scope and variety of electrical apparatus, the new Sprague Electric Co. will enjoy noteworthy distinction, standing foremost among the great concerns. It will, for example, make and sell the Sprague electric elevator system now so rapidly coming into use here and abroad; the Sprague "multiple unit system" of car operation, recently described in the papers, for meeting the varying conditions of traffic and travel on large passenger roads; the Johnson-Lundell surface contact system of street railway operation, to replace the trolley and open conduits; the interior conduit system of wiring, now represented by millions of feet of tube and thousands of installations; the Interior Conduit Co.'s standard motors and dynamos, for all classes of current generation and power purposes, and the Interior Conduit numerous ingenious specialties in switches, junction boxes, control instruments, etc. Additional to these is the new dynamo lately brought out by Mr. Lundell, which is promised to mark a distinct advance in the art, and upon which a large amount of work is now being done to meet orders for equipments.

It will, of course, be apparent that the new company will be in a position to furnish not only full outfits for electric lighting and power plants, for hotels, houses, office buildings, etc., but complete power installations, complete railroad systems, etc., and that its patents, facilities, and the men associated with it, make it at once a big factor in industrial electricity in America. At the present moment the Interior Conduit & Insulation Co. is extremely busy in all its varied branches, while the demand for Sprague elevators is enormous, and the Sprague system of unit control is being put on the Chicago South Side Elevated and other roads. In addition

to this, it may be noted that some of the new company's first shipments abroad will be a portion of the order for 49 Sprague elevators for the Central London underground road.

The directorate of the company is to be as follows: A. B. Chandler, chief managing director; E. H. Johnson, Carl Schurz, F. J. Sprague, Allan Bakewell, John E. Searles, W. M. Crane, John Markle, W. H. Baker and John Stevens. It is also understood that for the present, Mr. E. C. Platt, the treasurer of the Commercial Cable Co., will be the secretary and treasurer of the company. In due course announcement will be made of other dispositions made in regard to the conduct of the business.

ACCELERATION TESTS AT SCHENECTADY.

A SERIES of additional train acceleration tests were made October 7 on the experimental track of the General Electric Company, at Schenectady, in the presence of A. W. Sullivan, general superintendent; W. Renshaw, superintendent of machinery, and John Lundie, consulting engineer of the Illinois Central Railroad, and E. C. Carter, principal assistant engineer of the Chicago & Northwestern Railroad. Although the weather was most unfavorable and the runs made in a heavy downpour of rain, the results recorded were pronounced very satisfactory.

Our readers will recall that the Illinois Central Railroad has contemplated the adoption of electric traction in its suburban service, between Van Buren street station and Woodlawn, a distance of about eight miles, using the tracks over which that company carried on the enormous World's Fair passenger traffic. The tests in train acceleration made by the General Electric Company recently have been urged forward for the purpose of giving a clearer comprehension of the adaptability of electric traction, and of securing that acceleration from rest, which would satisfy the demands of a congested suburban traffic such as that with which the Illinois Central Railroad has to cope.

The car used on the occasion of these tests, was a standard elevated railroad car, weiging empty about 25 tons. It was equipped with four 50-W. P. motors, known as G. E. 57, one mounted on each axle, controlled by a standard series-parallel controller. In order that the officials present should be able to witness the actual performance of the car, the interior was equipped with voltmeter, ammeter, recording watt meter, and compensated chronograph, with bell attachment sounding at two second intervals. Attached to one axle was a Boyer speed recorder, with the gauge on a level with the window.

The car was driven by Mr. W. B. Potter, chief engineer of the G. E. railway department, and the tests were made under his direct supervision. A series of fourteen runs was made on the tangent of the experimental track—a stretch 3,000 feet long, and the results on the wet track showed that the car holding 20 people reached a speed of 19 miles per hour in five seconds; 30 miles per hour in ten seconds, 35 miles per hour in fifteen seconds, and 41 miles an hour in 20 seconds.

This was with a wet and greasy track. During the latter half of the test the rain ceased and a second series of tests was made with a drier track. The results were more favorable, and a speed of about 41½ miles an hour in 20 seconds was obtained.

Perhaps a better idea of these results may be conveyed by saying that an ordinary elevated steam train would reach a speed of about 14 miles an hour in the same lapse of time, while it would be only possible to accelerate it to the same speed in the same space of time by starting it on a down grade of about 15 per cent. The significance of such acceleration may still better be grasped by the fact that it would mean a saving of not less than 15 minutes in the running time over a distance of ten miles, with the same number of stops as in ordinary suburban or elevated service.

The tests are to be continued at Schenectady under varying conditions, that is, with different weights of cars and different equipment.

IMPORTANT LIGHTING CHANGES IN BALTIMORE.

The Northern Electric Company, owner of the plant and franchises of the corporation formerly known as the United States Electric Company, has been organized. Books were opened to receive subscriptions for the 6,000 additional shares of the stock authorized under the act of 1894, and for the balance of 1,940 shares of the stock of the Company, authorized by the act of 1890. The Board of Directors elected Mr. John M. Denison, president; Colonel Charles Marshall, vice-president; Mr. Chas. M. Armstrong, secretary and treasurer, and Mr. J. Frank Morrison, general superintendent.

Mr. Morrison had previously resigned the superintendency of the Maryland Electric Company. The franchises and plant of the United States Electric Company, which cost originally over $300,000, were purchased at public sale, made by the receivers of the Company, Messrs. Randolph Barton and C. M. Armstrong, by Mr. Benjamin L. Haines, a real estate broker, who represented the Guardian Surety and Trust Company, which is behind the Northern Electric Company. The price paid was $55,000, the next highest bidder being the Brush Electric Company, which bid $50,000.

The resignation of Mr. Morrison from the Maryland, and his assuming a similar position with the new company, has revived the rumors of a consolidation of the leading electric light companies of Baltimore. Those who discuss these rumors say that Mr. Morrison's change of position is the preliminary step, and his association with the Northern Electric Company puts him in a position to conduct the necessary negotiations for the desired consolidation. A prominent official of one of the companies, who is on the inside of all general movements among these corporations, said:

"Consolidation of the interests of the electric lighting plants in this city is entirely feasible, but I do not think the near future will see it an accomplished fact, even if it be admitted that the competition now threatened forces the stockholders to contemplate the wisdom and propriety of consolidation."

MR. TESLA ON HIGH SPEED ELECTRIC RAILROADING.

In an interview with a New York Journal reporter Mr. Tesla gives his views on high speed railroading. He says:

"The projectors of the road to be operated by means of the alternating current evidently realize what a vast undertaking they are entering into, as is indicated by their capitalization. First of all, it is not only practicable, but easy of perfection. The question of great speed will be greatly controlled by the quality of the track and the running gear on the cars. Properly constructed tracks, on level country, will permit a rate of speed as high as 150 miles an hour, and perhaps 200, as its stated by the president of the company, but it is certain that 100 miles an hour can be made with safety.

"So far as any personal discomfort is concerned, it is my impression that without curves and heavy grades such as are found on surface roads, the flight of a train traveling 100 miles an hour would not be any more unpleasant than one traveling 60. An air line road built eight feet above the ground, with no obstructions, and perfected running gear and heavy tracks, would cover the distance between here and Chicago easily in nine hours, and mail and light freight could even travel at the 150 mile rate.

"The venture is a big one—large enough, I should say, for the government to handle. It will revolutionize railroad travel and work great changes in commerce between cities wide apart.

"The popular impression that the speed is too great amounts to nothing. Balloonists have gone 150 miles an hour, and so far as a question of velocity is concerned, it depends upon the machinery and the excellence of the track. The human frame can stand the trip just as easily as at half that speed.

"If the General Electric Company has offered to sign a contract to equip the road I am satisfied that all the petty obstructions have been carefully investigated, and that the promoters mean business. Either the General Electric Company or the Westinghouse can supply the power if others will supply the capital. So far as the alternating current is concerned, it will supply the speed."

ELECTRICAL BRANDING OF SEALS UNSUCCESSFUL.

A special dispatch of Sept. 30 from Victoria, B. C., says: H.M.S. Wild Swan, returning to-day from patrol duty in Behring Sea, announces the complete failure of the electrical branding apparatus placed on the islands by Prof. David Starr Jordan and his staff.

Many attempts were made to brand the fur-bearing animals with the machine, but all were unavailing. Now the apparatus has been abandoned, and the seals are being branded with hot irons. Each seal is marked with a broad band, placed right across the back, looking like a waist band. The commercial value of the skins taken with this brand is greatly depreciated.

A party from the Wild Swan landed on both St. Paul and St. George islands about the middle of August, when very large herds were on the islands. There were seventeen or eighteen rookeries on St. Paul's, and in one visited there were fully 17,000 seals. Prof. Jordan had then left on the United States cutter Rush, but his staff, numbering six or seven, were still engaged in the work of branding the seals with hot irons. The stench of the burning had already been taken as a signal of danger by the sensitive seals, and they were migrating in large numbers to the northernmost Japanese islands, where the vessels of the Japanese fleet are reaping a harvest.

ITALIAN GENERAL EXHIBITION, TURIN, 1898.

On the occasion of the National Exhibition which will be held in Turin in 1898, to celebrate the fiftieth anniversary of the proclamation of the Italian constitution, exhibitors from all countries will be admitted to the special department of electricity. The electrical exhibition will be divided into the following classes: I. Electric and magnetic school apparatus. II. Materials and fittings for electrical mains and distribution. III. Electrical and magnetic testing apparatus. IV. Telegraphs and telephones. V. Railway signaling and block apparatus. Application of electricity to train lighting and heating. VI. Dynamo electrical machines and electric motors. VII. Mechanical applications of electricity.—Electric traction. VIII. Electric lighting. IX. Electro chemistry and electro metallurgy. X. Other applications of electricity. XI. Historical apparatus.

In issuing invitations to participate in the Turin Exhibition of 1898, to the electrical firms of all countries, the promoters are moved by the desire of presenting to visitors a complete display of exhibits from the best known Italian and foreign works, including the latest and most interesting inventions and improvements.—The promoters are convinced that, so far as electricity is concerned, nothing but a show, where makers and specialists of all countries are represented, will prove efficient in assuring progress both in science and industry.

Italy, where unemployed hydraulic power is still abundant, affords a large field to the enterprising spirit of electrical engineers. The success which crowned the international electricity exhibition held in Turin in 1884, where, besides many other practical results, the advantages of transformers were first brought into notice, justifies the hopes of the promoters, that foreign electrical engineering firms will accept the invitation and take part in the exhibition of 1898, thus contributing efficiently, with their specialties, to make it a display worthy of this important branch of industry. C. Gandellero is secretary to the president of the Commission of Electricity, and T. Villa is president of the Executive Committee.

EXTRAVAGANCE OF MUNICIPAL MANAGEMENT.

The respective statements of Mr. Thompson, the Director of Public Works, and of the president of the Bay State Gas Company, are not only interesting; they are instructive. They show that a quantity of gas superior in quality and equal to more than one-half that furnished the people of Philadelphia by its municipal works is supplied to Boston by about one-sixth of the number of men employed by the Philadelphia Bureau. As a matter of fact, the percentage in favor of the more economical and cheaper operation of the Boston works is very much greater than that, as the employés of the Philadelphia works do not make the entire supply of this city. They make only about 63 per cent. of it, a private company selling to the city about 37 per cent. of the total product. In other words, less than 300 men make all the superior gas used by the city of Boston, which is more than one-half of the inferior quality and the aggregate amount supplied to Philadelphia, while more than 1,700 men are on our pay rolls to supply 63 per cent. of the total consumption. This would give the Philadelphia works about eight employés to every single employé in the Boston works.

Why this enormously costly discrepancy exists is plain enough. The company which supplies Boston with gas is a private business concern that conducts its business on strictly business principles and according to business methods. The Philadelphia concern is virtually a political machine, which conducts its affairs upon political lines.—Philadelphia Ledger.

TROLLEY CONDUCTOR FRAUDS AT ALBANY, N. Y.

The discovery of a conspiracy among about a dozen employés of the Albany Railway Company, by which the company during the last year has lost more than $20,000, has been followed by the arrest at Albany, N. Y., of James Bain, a clerk in the company's office; Peter Brannigan, electrical inspector, and four conductors. Warrants were issued for five more conductors. Bain and Brannigan confessed after arrest. The plan consisted in returning cancelled tickets to the conductors, who would turn them in again, instead of cash fares, the stealings being divided.

PITTSBURG, PA.—The Pittsburg "Press" devotes considerable space to the report that the Pennsylvania Railroad will run trains between the Union Depot and Walls, a suburb, by electricity, in order to even up against the trolley competition.

OBITUARY

ALBERT L. IDE.

We regret to announce the death of Mr. Albert L. Ide, senior partner of the firm of A. L. Ide & Sons, proprietors of the Ide Engine Works, of Springfield, Ill. He was born in Waupaukoneta, Loraine county, Ohio, in March, 1841. He enlisted at the first call of troops in the Civil War in the Seventh Illinois Infantry, and at the expiration of service was drill master at Camp Butler, again entering active service as Major of the Thirty-second Illinois Infantry. He was honorably discharged for disability after a severe attack of typhoid fever. After the close of the war he built and equipped the Springfield City Railway's Fifth street line and became president of the Company. He next engaged in the steam heating business in 1870, with his office and shops in the old Rudolph Opera House. In 1876 he purchased from the city the Market House property, under an agreement to operate a machine shop in the building for ten years. To this building additions and improvements have been made from time to time, until now the property covers one-half block and furnishes employment for a large number of men. In 1893 Mr. Ide bought a large interest in the property of the National Electric Company, at Eau Claire, Wis., of which he was president. He was best known in manufacturing circles as the inventor of the Ide engines, which are in very extensive use, especially in the field of electric light and power.

EDUCATIONAL

UNION COLLEGE, SCHENECTADY, N. Y.

This institution is calling special attention to its engineering school and courses, and has issued a circular on the subject. Attention is directed to the facilities granted by the General Electric Company, by which students are admitted to the works at regular scheduled times for instruction. The professor of engineering is Mr. Olin H. Landreth, to whom requests should be made for catalogues or further information.

LEGAL NOTES

ELEC. SUPPLY & CONS. CO. vs. VERONA TOOL WORKS AND THE E. S. GREELEY & CO.

Judge J. W. F. White, of Pittsburg, handed down an opinion making absolute a rule for judgment on the Electric Supply and Construction Company, garnishee, in the suit of the Verona Tool Works, against E. S. Greeley & Co. E. S. Greeley, receiver of E. S. Greeley & Co., a Connecticut corporation, obtained judgment against the Electric Supply and Construction Company Feb. 10, 1897, for $1,631.49, on which an execution was issued. On Feb. 25, 1897, the Verona Tool Works issued a foreign attachment against E. S. Greeley & Co., which was served on the garnishee, which admitted owing the judgment. The question then arose as to whether the receiver or the attaching creditor is entitled to the money. Judge White says: "If no receiver had been appointed there can be no doubt that the attachment would hold the fund against the corporation. Has the receiver any higher or superior right? The case is somewhat similar to a voluntary assignment. If a creditor in Connecticut had come here and issued an attachment to seize this fund and thus get a preference, we would not on principles of comity then permit him to get a preference. But that principle does not apply where the attaching creditor is a citizen of this State. On the contrary, we will rather favor our own citizen and not let the funds go out of the State and drive him into another State to seek his claim against an insolvent concern. We will not recognize

the receiver as possessing any greater rights in this State than the corporation had."

COMPENSATION BEYOND A LICENSE FEE ON CARS RUN DENIED IN CHICAGO.

President C. L. Bonney, of the Chicago General Electric Railway Company, acting in the interests of Yerkes's lines and the Chicago City Railway Company, has filed a brief in the Supreme Court of Illinois, in which he boldly attacks the right of a city or other municipal corporation to demand any compensation, beyond a license on the cars run, from a street car company in consideration of being allowed the use of the public streets.

The brief was filed in the appeal of the Chicago General Electric Railway Company from the suit of the city in which the latter seeks to control the $500 a mile compensation, which is agreed on in the former's franchise ordinance. Its scope is much wider than this, however, as the principle set up is that the city cannot demand such compensation in any case.

If the Supreme Court should sustain Mr. Bonney's position, its decision will apply to the ordinances extending the existing street car franchises under the Allen law when they are introduced in the city council. Mr. Bonney's argument applies to gas, telephone and other franchises, as well as those of the street car companies.

THE STOCK MARKET

TRADE GOOD BUT STOCKS DULL.

The business payments through banks in September were the largest ever known in that month by $268,000,000. The railroad returns for September were 12.8 per cent. larger than last year. The failures for the quarter were smaller than in any quarter since 1892. Gold shipments have begun on a large scale; imports are not heavy; the value and bulk of exports is well nigh unprecedented, and general business is improving all through the country, except at the few points affected by the yellow fever scare.

The stock market has been under bear pressure for some time, owing to the late rapid advance, but remains dull and strong. Last week 21,999 shares of Western Union were sold at prices down to 88¾. General Electric receded to 35¾ on sales of 13,350 shares. American Bell, on small sales, has settled back to 265, with an upward tendency. New York Edison is 126⅛, little stock offering.

Copper is quiet; lake ingot, 11¼; electrolytic, 11 to 11⅛.

Steel rails were quoted at Pittsburg at $19.

INVENTORS' RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPTEMBER 28, 1897.

Alarms and Signals:—

SIGNALING FOR ELECTRIC RAILWAYS. J. B. Struble, Wilkinsburg, Pa., 590,599. Filed January 2, 1897.
Employs the same current to operate both the cars and signals.

SIGNALING. J. B. Struble, Wilkinsburg, Pa., 590,600. Filed May 20, 1897.
Similar to above.

ELECTRIC FIRE ALARM SYSTEM. J. L. & G. B. Walker, Pensacola, Fla., 590,603. Filed January 12, 1897.
Employs telephones in a closed circuit.

Batteries, Secondary:—

SECONDARY BATTERY. M. De Contades, Paris, France, 590,930. Filed February 9, 1897.
Comprises a battery plate, an inclosing casing of non-conducting material having expansible joints, and a holding band of expansible conducting material surrounding and united to the casing and provided exteriorly with cells filled with active material.

Conductors, Conduits and Insulators:—

INSULATOR. F. M. Locke, Victor, N. Y., 590,806. Filed December 16, 1896.
An insulator having its outer skirt oblong, and means for conducting the moisture toward its lateral extremities.

INSULATOR. F. B. Grimm and J. H. Nessler, Quincy, Ill., 590,832. Filed Jan. 4, 1897.
Is provided in its top with a transverse sigmoidal wire-receiving groove having downwardly convergent side walls formed with a plurality of upright channels.

Distribution:—

ELECTRICAL TRANSFORMER. W. D. & J. W. Packard, Warren, Ohio, 590,852. Filed May 5, 1897.
Comprises core plates composed each of inner and outer portions and end pieces, all formed from one strip of magnetic metal.

Electro-Metallurgy:—

PROCESS OF AND APPARATUS FOR ELECTRICALLY TREATING ORES. F. H. Soden, Chicago, Ill., 590,673. Filed July 13, 1894.
The ore is heated by electricity and superheated air and a purifying gas are introduced into it.

PROCESS OF TREATING REBELLIOUS ORES. W. L. Brown, San Francisco, Cal., 590,801. Filed Nov. 25, 1895.
Consists in adding a suitable compound to ores and water, containing an element having chemical affinity for the base constituents of the ore, and then subjecting to electrolytic action.

MAGNETIC ORE SEPARATOR. L. G. Rowand, Camden, N. J., 590,808. Filed Dec. 22, 1896.
Employs an electric machine to generate the magnetic field and to drive the conveying belts, etc.

MAGNETIC ORE SEPARATOR. L. G. Rowand, Camden, N. J., 590,809. Filed Jan. 22, 1897.
Similar to above.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. A. Poulsen, Buffalo, N. Y., 590,670. Filed July 29, 1897.
An electric contact for sliding rods in arc lamps, consisting of a barrel with cover, having rings of packing, and containing small particles of a good conducting material.

ELECTRIC ARC LAMP. H. Leitner, London, Eng., 590,725. Filed April 16, 1897.
Feed mechanism embodying two coils, one coil being in series with the lamp and the other in shunt circuit.

INCANDESCENT LAMP. J. Bradley, Boston, Mass., 590,786. Filed October 15, 1896.
Comprises filament supports, consisting of an alloy of platinum and a baser metal.

INCANDESCENT ELECTRIC LAMP FIXTURE. B. B. Hoffman, New York, 590,838. Filed February 6, 1897.
Comprises a base for holding a battery and an ornamental standard and fixture for the lamp.

Measurements:—

RECORDING WATTMETER. W. H. Pratt, Lynn, Mass., 590,648. Filed May 15, 1897.
Consists of an astatic motor mechanism, comprising more than a single armature winding, which respectively act under the influence of magnetism in opposite directions to rotate the shaft in the same direction, and a damping mechanism.

ALTERNATING CURRENT METER. R. Shand, Lynn, Mass., 590,650. Filed March 12, 1897.
Comprises a current coil, a potential coil, a transformer whose primary is coupled across the circuit-mains, and a third coil in the secondary circuit of the transformer, all coils being in inductive relation to the rotating armature.

SHIELDING DEVICE FOR ELECTRIC METERS. E. Thomson, Swampscott, Mass., 590,653. Filed May 21, 1897.
Comprises an armature, field coils, a magnetic damping mechanism, and a copper shield forming the seat of induced currents surrounding the field coils.

ELECTRIC MEASURING INSTRUMENT. E. Thomson, Swampscott, Mass., 590,654. Filed June 17, 1897.
Embodies in its construction a fixed coil located at an angle and a movable coil located within the fixed coil at an angle thereto.

Miscellaneous:—

POROUS DIAPHRAGM FOR ELECTROLYTIC APPARATUS. J. D. Darling, Philadelphia, Pa., 590,826. Filed October 21, 1896.
Consists of a support and a granular filling consisting principally of vitrified magnesia.

ELECTRIC HEATER. R. A. L. Snyder, Pittsburg, Pa., and A. F. Tinnerholm, Detroit, Mich., 590,916. Filed December 22, 1896.
Consists of a series of layers of resistance wire, sheets of insulating material and heat conducting copper strips built up around the cores.

Railways and Appliances:—

ELECTRIC TROLLEY DEVICE. A. B. Du Pont, Detroit, Mich., 590,589. Filed January 15, 1897.
Comprises a transverse shaft and a contact wheel surrounding it, and a carriage carrying the contact wheel, adapted to move along the shaft, and adapted to run partially about it.

MAGNETIC BRAKE. W. Stanley, Pittsfield, Mass., 590,777. Filed July 31, 1897.
Consists of a permanent magnet having a stationary body portion, means for varying the air-gap between its polar projections, and a metallic disc lying in the field between the poles and free to revolve therein.

CONTROLLER CIRCUIT BREAKER. T. Von Zweigbergk, Cleveland, Ohio., 590,813. Filed March 15, 1897.
Combines a controller having contact fingers for governing the motor, and a circuit breaker having contact plates for governing the controller.

ELECTRIC RAILWAY. J. W. Darley, Jr., Baltimore, Md., 590,881. Filed Jan. 13, 1896.
Surface contact system. Details of construction.

ELECTRIC RAILWAY. J. W. Darley, Jr., Baltimore, Md., 590,882. Filed August 1, 1896.
Similar to above.

Switches, Cut-Outs, Etc:—

SAFETY FUSE FOR ELECTRICAL DEVICES. D. J. Cartwright, Boston, Mass., 590,750. Filed April 19, 1897.
Consists of an air-tight case enclosing the entire fusible metal, a filling of asbestos at each end of the case, a definite air space between the fillings, and a fuse wire passing through the fillings and the air space.

RHEOSTAT. T. M. Pusey, Kennett Square, Pa., 590,910. Filed February 3, 1897.
Adapted for use in connection with voltage regulators. Details of construction.

Telegraphs:—

PRINTING TELEGRAPH. R. Kubler, Berlin, Germany. 590,664. Filed September 8, 1896.
Details of construction.

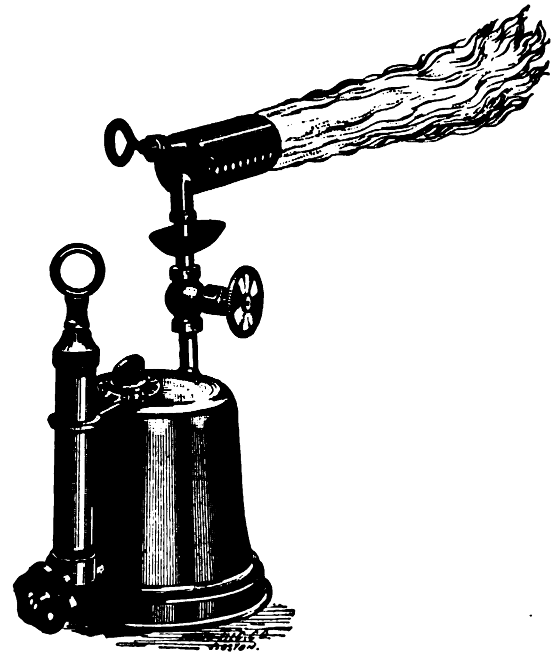
Telephones:—

TELEPHONE SYSTEM AND TELEPHONE EXCHANGE MECHANISM. H. P. Snow, Erie, Pa., 590,633. Filed September 19, 1896.
A system operating telephones equal to the product of the number of outgoing wires by the number of incoming wires.

TRADE NOTES & NOVELTIES

THE GLOBE BLOW TORCH.

THE Globe Gas Light Company, 77 Union street, Boston, have introduced a blow torch with several commendable features, for use in soldering wires and other kindred purposes where an intense heat is desired. Nothing but copper and brass are employed in its construction, which is such as to render it almost indestructible. Several leading electric light

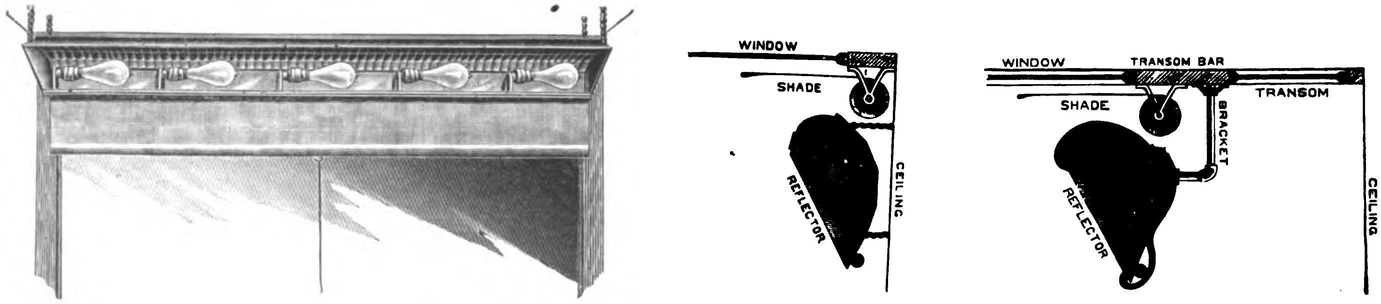


THE GLOBE BLOW TORCH.

and railway companies throughout the United States are using it, and find it especially adapted to out-door work, as the wind, however strong it may be, cannot blow it out. It is also found to be a great convenience for thawing pipes. A full line of gasoline furnaces and torches is always carried in stock by this Company, who will supply all information upon request.

THE FRINK WINDOW REFLECTORS.

TO derive the benefit of display a show window must be well lighted. With this object in view, Mr. I. P. Frink, 551 Pearl street, New York, has recently placed upon the mar-



FIGS. 1, 2 AND 3.—THE FRINK WINDOW REFLECTORS.

ket an excellent window reflector for electric lights, capable of almost any adjustment. It is illustrated in the accompanying engravings, of which Fig. 1 shows the reflector with several lamps, placed in the window at the top, close to the front glass, and so arranged as to throw the light inward and downward upon whatever it is desired to display, and at the same time shield the observer from the direct rays. Its use is not confined to windows, but it may be installed with advantage in art galleries, stock exchange boards, and, in fact, any place where a good light is essential. Fig. 2 shows an end view of the reflector attached to a window transom by bracket support. Fig. 3 shows the method of suspension from a ceiling by means of loops and chains. An 8-page folder, descriptive of the celebrated Frink reflectors, giving detailed informataion as to sizes, prices, etc., will be sent to those requesting it.

C & C MOTORS.

The C & C Electric Company, 143 Liberty street, New York, report a most gratifying demand for their several new types of machines, especially for their excellent new line of multipolar generators and enclosed iron-clad motors. They are constantly securing contracts for electric power transmission equipments, including both these types of machines, besides large orders for these and their older types. Their enclosed iron-clad motor seems to have filled a "long felt want," inasmuch as numerous orders for them have come from unexpected sources. This machine was designed especially for use in mills where dust, gases or moisture predominated and where such a machine was necessary, but instead of their orders being entirely for application in such places, customers are daily springing up who want the motors for use in almost every other conceivable place.

PIERCE & MILLER ENGINEERING CO.

The Pierce & Miller Engineering Company reports a strongly marked increase along all its lines of business, following the return of its president, F. M. Pierce, from his tour around the world, during which he made many valuable connections. From observations he made while abroad he decided that America would do a large European business in furnishing equipments for electric tramways, and to accommodate this, and the rapidly increasing home trade, a large increase in this Company's engineering and selling force has been drawn from England and Ireland. Mr. Pierce has made strong financial connections in London and New York, which enables his Company to "finance" electric railway and other first-class enterprises.

This Company reports work in hand as follows: One 300, three 1,200, three 800 h. p. and several hundred horse power in small engines, and one complete railway power plant.

This Company is now handling the Rice-Sargent engine for large work, and the "Standard" Ball, of Erie, for the smaller high and medium speed electric purposes.

STREET CAR AIR BRAKES IN ENGLAND.

While General Manager Wessels, of The Standard Air Brake Company, was in Europe he noticed that the powerful Board of Trade in London permitted the use of electric brakes on tram cars in England and Ireland, but that there was no reference made in the government specifications to air brakes. He took up the matter at once actively with the secretary and volunteered to discuss before the Board of Trade the question of the relative merits of air brakes and electric brakes. The board advised him that it was contrary to precedent for them to have such questions orally discussed before them, but that they would be glad to hear from him in writing on the subject. Mr. Wessels' faith in air brakes is so unbounded that he presented an exhaustive argument to the board, in which he showed how widely Standard air brakes had been adopted in Europe and that they had become standard and were mentioned in all the specifications in Australia. After weighing his arguments, the Board of Trade sent a letter to Mr. Wes-

sels before his departure for America, reading as follows: "With reference to your letter of July 8 on the subject of the use of air brakes on tram cars, I am directed by the Board of Trade to inform you that they are advised that there is no reason why an efficient air brake should not be allowed by the department." It will thus be seen that there is no obstacle whatever in the way of Standard air brakes being adopted by any of the tramways in the United Kingdom, and we congratulate The Standard Air Brake Company on the success achieved in the public welfare.

THE WILLYOUNG DIRECT-READING POTENTIOMETER.

WE illustrate herewith a new form of direct reading potentiometer recently put upon the market by Willyoung & Co., of Philadelphia. The first of these instruments was de-

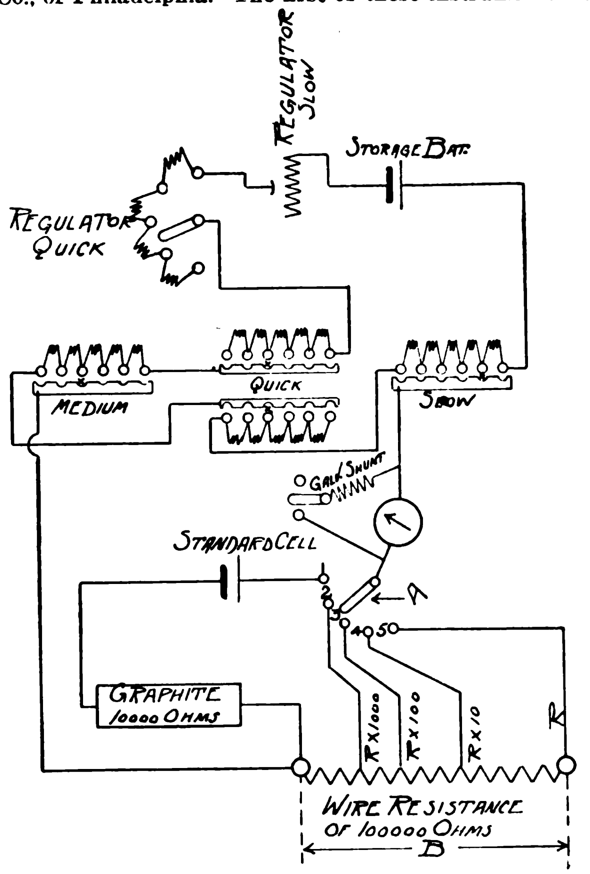


FIG. 2.—WILLYOUNG DIRECT-READING POTENTIOMETER.

signed for and supplied to the new standardizing laboratory of the Electrical Engineering Department at the University of Nebraska. Fig. 1 illustrates the apparatus in perspective and Fig. 2 shows the parts of the apparatus in outline diagram.

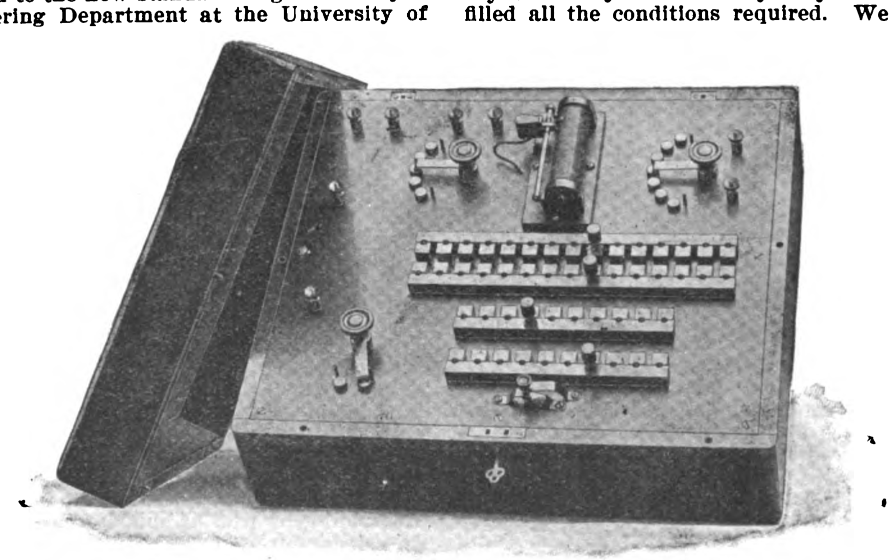


FIG. 1.—WILLYOUNG DIRECT-READING POTENTIOMETER.

The general scheme will be seen to be essentially the same as that used in the potentiometer discussed by Mr. Willyoung in a paper read before the American Institute of Electrical Engineers in Philadelphia in 1893. The main potentiometer circuit contains three groups of adjusted resistances, viz.: "Quick," "Medium" and "Slow." There are nine coils in "Slow," each of 0.08 ohm resistance. "Medium" has nine coils also, each of 0.8 ohm resistance, or ten times that of a coil of "Slow." In "Quick" there are two sets of coils, fourteen in each set, and each coil of eight ohms resistance. By means of this "Quick" group one is enabled, if he keeps plugs in corresponding holes of both bars, to take resistance out from between the galvanometer circuit terminals, while maintaining the resistance of the main circuit always constant.

In the operation of the instrument switch A is turned to point 1, thus opposing the standard cell circuit to that of the storage battery. The plugs of "Quick," "Medium" and "Slow" are then set to read off the value of the standard cell. "Regulator Quick" and "Regulator Slow" are not adjusted until there is no deflection of the galvanometer on closure of the circuits.

To measure now any unknown e. m. f. the same is joined to the binding posts B, turning switch A to one of the points 2, 3, 4 or 5, depending upon the probable value of the unknown e. m. f. The plugs are moved till balance is obtained, and the plug settings read, which will be the e. m. f. desired.

The potentiometer is capable of measuring e. m. f.'s up to 1,000 volts with an accuracy of 1-10 per cent. Currents of any value may be measured by means of a standard known low resistance; the unknown current should be passed through this and the P. D. produced by this current at the terminals of the resistance measured by the potentiometer.

Mr. James G. Biddle, selling agent for the Willyoung apparatus, will be pleased to give further details regarding this instrument.

PIONEER ENCLOSED ARCS.

The indications, from the orders which have been placed with the Electric Arc Light Company, makers of the "Pioneer" enclosed arc lamps, are that there is a special movement among dry goods people in connection with the revival in trade. Among their New York orders they report just having closed with the dry goods firm of H. O'Neill & Co., Sixth avenue and 20th street, for the equipment of their establishment with "Pioneer" lamps. They state that this order was obtained as a result of a test where their claims were fully established for the highest efficiency, the lowest consumption of current and steadiness, and also as demonstrating their type of mechanism as against the direct carbon feed lamps.

PLASTIC BONDING AT HINGHAM, MASS.

Pepper & Register, of 1414 South Penn Square, Philadelphia, under date of Sept. 13, write as follows to Mr. Harold P. Brown:

In reply to a letter sent to us by your Mr. Sheble, regarding the Plastic bonds of the Hingham street railway, we would say that they are in every way satisfactory and have fulfilled all the conditions required. We had occasion to open a few joints a month ago, and found the bonds to be as perfect as when first applied—over fifteen months ago. The re-

turn circuit of the railway is so good that we have been able to furnish power nine miles from the power house with but a single No. 0000 feeder and a No. 00 trolley, for eight crowded cars at a time on that long branch of the road. The road is single track with 60-lb. T-rail. We strongly recommend the adoption of the Edison-Brown plastic bond as an economy for electric railways.

THE SIXTY-SIXTH AMERICAN INSTITUTE FAIR.

THE American Institute, of New York City, is now holding its sixty-sixth annual fair at Madison Square Garden, with the usual miscellaneous collection of novelties in various lines of trade and invention. At the present moment, many of the exhibits are not in place, but enough is seen to confirm the belief that the fair will be quite up to those of recent years in extent and interest.

THE HARRIS AUTOMATIC PRESS COMPANY, of Niles, O., shows a very interesting group of their presses for automatic card and envelope printing. Each is run by a small Crocker-Wheeler motor on the base plate. The cards or envelopes are fed into a holder and then are printed, falling into a circular hopper, which travels slowly, and enables them to be gathered up neatly and quickly when dry.

OTTO GAS ENGINE WORKS, of Philadelphia, A. C. Manning & Co., 39 Cortlandt street, agents, have an excellent exhibit of three sizes and types of their famous gas engines, one of which is connected to an Eddy generator. The exhibit is so run as to enable the visitors to understand the features of economy, steadiness, smoothness, freedom from noise, and small space required, and the throng around the space testifies to the interest felt. This exhibit is right on the main floor of the Garden.

JOHN A. ROEBLING'S SONS COMPANY have an exhibit of their special fireproof construction and wire lathing for wooden buildings. The exhibit illustrates the nature of the materials used, and the method of constructing walls with it.

NILES TOOL WORKS COMPANY, 136 Liberty street, have a neat display of some of their machine tools and steel pulleys.

MR. AUGUST MIETZ, Mott street, exhibits his Mietz & Weiss kerosene engine, using common oil 150 deg. test, said to run at ½ cent per horse power hour.

JAMES H. MASON Co., 67 Liberty street, Brooklyn, has an exhibit of his well known primary batteries and special solutions and motors to be run from same.

BALL & WOOD CO., 120 Liberty street, have in the machinery annex, under the main floor, one of their single engines set up, resting right on the brick floor without any piers or bracing. It is of 125 h. p., at 275 revolutions per minute, and is running beautifully under all variations of load, supplying power to a long line of shaft that has hitched to it a variety of power-consuming apparatus and machinery. The exhibit is a good example of absolutely smooth running, and the engine itself is a fine example of machine production.

MR. GEORGE KIRKEGAARD, of 86 Fulton street, has a neat working exhibit, with live rats of his electrical animal trap. In one compartment is put the bait. As the rat approaches it ensnares itself in a corresponding compartment, and electrically releases the baited section, besides closing the path of retreat. The rat can now only go forward into the general trap and as it reaches that it electrically swings back the bait into position for another victim. One or two cells of battery suffice to energise the operating magnets. Mr. Kirkegaard is now building a big trap to catch wolves in Montana.

SIEGEL-COOPER'S BIG STORE has near these exhibits a working creamery, driven by an Eddy motor, the visitors being able to see the butter made by the churn, from Delaware county milk.

MR. T. R. ALMOND, of 83 Washington street, Brooklyn, well known as the inventor of the Almond right angle counter shaft and the Almond flexible gas brackets and the Almond drill chuck, has an exhibit of his rotary steam engines, in which is seen another ingenious attempt to deal with a fascinating problem.

AMERICAN GAS FURNACE COMPANY, 23 John street, have an interesting exhibit on the main floor of their American oil gas machine, Jacobson gas engine, gas blast furnaces, automatic heating machines and a variety of other devices based on the use of oil gas and heat.

THE ACME GAS ENGINE COMPANY, 15 Cortlandt street, have an exhibit of their gas and gasoline engines, built in sizes from one horse power upward.

WARING ELECTRIC CUTTER COMPANY, 393 Pearl street, have a highly ingenious and effective little tool on exhibition, cutting through piles of cloth and flannel. The power is furnished to this self-contained appliance by a Crocker-Wheeler motor, which is geared to the revolving blade and the whole rests on a bed, a handle enabling the operator to steer it along in any direction. It works on 110-volt current, with light ampereage, dependent on the thickness of the material to be cut. The machine weighs 21 pounds complete, and stands 12 inches high. The circular knife is 4 inches in diameter and will cut almost its entire height through a "lay." It is said that one of them will cut as much as ten men.

SPIKES AND SPLICES.

When a railroad company starts to lay 300 or 400 miles of new 85-pound steel rail as the B. & O. is doing, it costs money for ties, spikes, splice bars, etc., etc. The B. & O. has adopted certain track standards, and according to the book it takes 133.57 tons of 85-pound rail for one mile of track. Ties are laid 24 inches from center to center, making 2,640 per mile. Four spikes per tie calls for 30 kegs, or 10,800 spikes, weighing 6,000 pounds, or three tons. In each mile of 30-foot rail are 352 complete joints, requiring 704 splice bars and 1,408 bolts. The B. & O. uses what is known as the "continuous rail joint splice bar," which is supposed to prevent low joints, the bane of a trackman's life.

CROCKER-WHEELER BELT TYPE MACHINES.

Bulletin No. 4, June, 1897, of the Crocker-Wheeler Electric Co., is a handsome pamphlet of 52 pages, profusely illustrated. It is devoted to the company's belt type of machines, and gives many details as to their sizes, weights, space, speed, etc. It has been compiled with much care, and is a very fine specimen of technical trade literature. The company will be glad to send copies to any one interested, or needing belt driven motors and dynamos.

THE DUTY ON ARC LIGHT CARBONS.

A special dispatch from Washington of October 7 says: "When the Dingley tariff bill was under consideration in the Senate Mr. Quay called attention to the phraseology fixing the duty on carbons for electric lighting for the purpose of having it made more specific. The rate fixed was 90 cents a hundred, there being no limitation of size. The Senator suggested that under this loose construction dealers could increase the length of the carbons, and, after importation, cut them into proper lengths for use, thus escaping the payment of a large proportion of the duty that properly should be collected. He was not successful, however, in securing the change desired. Appraiser Wakefield has now notified the department that the carbons are coming in in lengths of 32 inches, from which three carbons of commercial size are made, and importers are insisting that they are subject to a duty of 90 cents a hundred only on the extended lengths. When Mr. Wakeman was in Washington the other day the subject was discussed by himself and Assistant Secretary Howell. No formal instructions were issued, but it is understood that Mr. Wakeman will construe the law to mean carbons as used in electric lighting, and the extended lengths will be assessed for duty on that basis.

NEW BROOKLYN TROLLEY CARS.

The Brooklyn Heights Railroad Company has contracted for sixty new trolley cars, which are now in course of construction, to be placed upon the various lines which it controls. They are designed to meet the growing demands of traffic, to replace old-style cars which are worn out, or at least undesirable, and to improve the accommodations supplied to the patrons of the company. It is expected that all of the new cars will be received, ready for use, by October 15, and they will be put in operation immediately. Forty of them are being built in St. Louis and twenty in Philadelphia. These cars are all of the eight-wheel, double-truck pattern.

The new vehicles will be of the same design as those which the Brooklyn Heights Company provided last year. Each car has a 25-foot body, and measures 35 feet over all. The platforms are much more commodious than those on the old-style cars, and the floor space in the new cars is three inches wider than that in their predecessors. The door at the end is so placed in the side of the car that people can pass through it without inconvenience when others are standing on the platform.

All the windows are stationary, for reasons explained by Ira A. McCormick, the general manager of the company. He said that the company intended to provide a winter equipment for winter, as well as summer cars in summer, and that the closed cars were well ventilated at the top. Therefore, the windows in them were made immovable, so that "fresh air fiends" could not push them up in cold weather, exposing delicate women and others to discomfort and danger from chilling draughts on the back of the neck.

The cars are brilliantly lighted by electricity, the lights being

at both top and sides, enabling passengers to read their newspapers with ease. Electric call bells are placed at the side of each window, relieving the passenger of the old-time struggle to attract the conductor's attention when he wishes the car to stop. Now he simply pushes a button and the conductor does the rest. The seats in the new cars are of cane, comfortable and cleanly, and preferable to upholstered seats from a sanitary point of view.

PROPER MANAGEMENT OF ELECTRICAL PLANTS THAT HAVE NOT BEEN PAYING.

The U. S. Electrical Supply Co. have recently entered upon a new and novel field. They arrange to assume the entire management of any electrical plant that has not been paying as it should have been, and by means of expert supervision and proper enterprising business management they seldom fail to put the property on a good, sound, paying bisis. Great success should attend this new venture, as it certainly fills a long felt want, and should prove a boon to many who have invested in poorly managed electrical plants, and have waited long and patiently for dividends that never come under such circumstances.

THE P. & B. INSULATING SPECIALTIES ABROAD.

The P. & B. electrical compounds, P. & B. tape, P. & B. armature varnish, as well as some grades of the P. & B. insulating paper, have been in use in various parts of Europe for the past six years or more. They have satisfied consumers in all respects, but the drawback of the length of time necessary to have orders dispatched from this country, as well as the high tariff existing in Germany—in which country and Great Britain they have had a specially large field—seriously interfered with the natural increase of the business. The company decided last January to make the P. & B. products more readily available to European markets, and after a thorough examination of the situation by President Shainwald, the decision was reached to erect a large and complete factory in the city of Hamburg. The factory is most eligibly situated, being on the River Elbe, making it possible to receive all products, and ship all finished goods by water to any part of the world, without any other handling than that of water transportation pure and simple.

The sales office of the company is in charge of the very favorably known firm of Messrs. Allut Noodt & Meyer, at 33 Grimm, Hamburg. The Hamburg works will be ready next month, to accept and deliver orders for all the P. & B. products used in the electrical industries. The business of the factory is confined to European markets. The North and South American business, and other points more accessible from the United States, will continue to be supplied by the American works of the Standard Paint Company.

In view of the fact that many American electrical engineers and managers are now resident in Europe, connected with large electrical interests there, and are acquainted with the P. & B. products, this item of news may be of some interest to many of our readers abroad.

Mr. Robert W. Blackwell, of 39 Victoria street, Westminster, S. W., London, is the representative of the company in Great Britain, and for France, Belgium, Holland and the colonies.

THE GOLD'S ELECTRIC CAR HEATER.

FOR the past three years the Gold Street Car Heating Company, northeast corner Frankfort and Cliff streets, New York, have been busily engaged in the manufacture of electric heaters of many different styles and sizes for various uses. They have made a number of improvements in the construction of their devices during that time, but none so pronounced as in the heater which has recently been developed and patented by Mr. Edward E. Gold, the president of the company.

In this heater it is possible to use the largest amount of re-

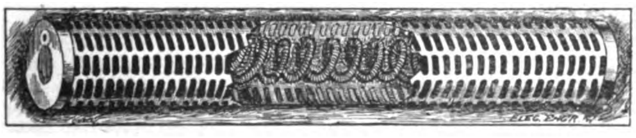


FIG. 1.—THE GOLD'S ELECTRIC CAR HEATER-COIL.

sistance wire of which any heater of the same dimensions is capable, and at the same time maintain a perfect and free circulation of air over the heated resistance wires, so that all of the current used is converted into heat for use in the car body. thereby attaining the very highest possible efficiency for an electric heater.

As may be seen from the accompanying illustration, Fig. 1, the heater casing contains a spiral, which is fixed in a horizontal position. This spiral is made of the very best ¼-inch iron rod, and thoroughly covered with non-conducting enamel which will stand nearly 3,000 degs. of heat.

The resistance coils, which are of ⅜-inch diameter, are then slipped on to the enameled spiral and made fast at both ends of the heater. In this way a maximum amount of resistance wire can be used in a heater to the very best advantage, and the results obtained from very extensive tests recently made

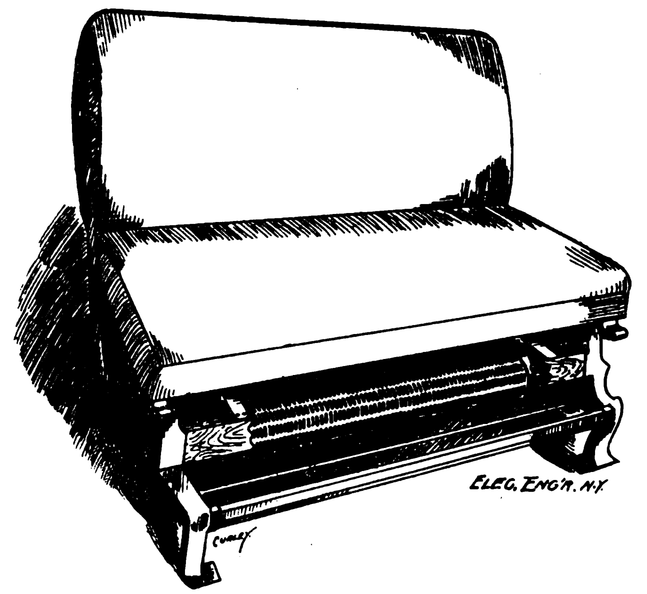


FIG. 2.—THE GOLD'S ELECTRIC CAR HEATER.

show that this heater is highly efficient. The electric current can be turned on to the coils separately so that 3 degs. of heat can be had.

Fig. 2 shows the heater in connection with the Hale & Kilburn "Walk-Over" Seat.

Mr. Gold, who is a heating engineer of long and most successful experience, has taken great pains in the construction of this, his latest heater, to allow of a free circulation of air over the heated surfaces, believing as he does, in common with other heating engineers, that to most thoroughly heat cold air it must be first separated into the minutest portions and brought in contact with the heated surfaces simultaneously.

This same principle of holding resistance wires on enameled spirals is now being used in several different forms and styles of heaters by the Gold Street Car Heating Company.

MUNSELL'S MICA.

Eugene Munsell & Co., miners and importers of mica, New York and Chicago, will exhibit their line of India and Amber mica at the Street Railway Convention to be held at Niagara Falls. Mr. Franklin Brooks, of the New York house, and Mr. Chas. E. Coleman, manager of the Chicago branch, will be in attendance. The exhibit will be in connection with that of the Mica Insulator Co., occupying space No. 11, and will consist of mica in the sheet as it comes from the mines, mica segments, and a variety of cut sizes as used by the electrical trade generally. A souvenir in the form of a puzzle will be given to those who call at the booth. This little novelty is known as the "Mica Mine Puzzle." The idea is to get all the miners into one mine. It is not easy.

W. J. C. INCANDESCENT LAMP.

The U. S. Electrical Supply Co., 120 Liberty street, New York, can justly feel proud of the success which they are meeting with. Their W. J. C. incandescent lamp is having an immense sale and the factory is running 20 hours per day in order to keep pace with the demand; about 3,000 lamps per day are now being turned out. The firm attribute their phenomenal success to the fact that the long life and high efficiency of their lamps cause them to give universal satisfaction wherever used, and the prompt business methods of the company have made them many fast friends, it being one of their rules that all correspondence must be answered by first mail no matter how unimportant it may appear. The company are looking for a few more good, live agents to represent them in Greater New York, and some other cities where all of the territory has not been arranged for as yet.

WELDON'S HAND-MADE CLIMBERS.

THESE climbers are too well known to electric railway and light and telephone and telegraph men, to require any detailed description beyond that conveyed by the accompanying engraving.

These climbers have long been noted for their superior quality of steel and workmanship. When the spurs have been

WELDON'S HAND-MADE CLIMBERS.

worn down new ones can be inserted and the climbers made as good as new.

Messrs. James S. Barron & Co., 24-30 Hudson street, New York, selling agents for the Weldon climbers, offer to the attendants at the Street Railway Convention at Niagara a pair of handsome nickel plated climbers to accompany every order for a dozen pairs climbers or more.

CITY PLANT FOR COLUMBUS, O.

A resolution for the establishment of an electric light plant for Columbus, O., has passed its first reading. The city proposes to issue $300,000 in 5 per cent. 20-year bonds.

GALE'S COMMUTATOR COMPOUND.

In answer to an inquiry from a representative of this journal recently, Mr. Isaacs, of K. McLennan & Co., stated that while no doubt the conditions in the business world had materially improved, and while the sales of Gale's Commutator Compound have increased, he did not believe that such increase in the sales of their Compound could fairly be attributed to the times. Gale's Commutator Compound has become a staple article, adopted and in regular use by nearly every power plant and central station in the United States and Canada and a vast number of isolated plants. In the fall season or beginning from September 1, a very much larger quantity of Compound is used than in the summer and in his belief, this is the real cause of the increased sales. Doubtless, continued Mr. Isaacs, the reduction in price of Gale's Commutator Compound from 75 cents per stick to that of 50 cents has worked some increase, as some of the smaller plants may have felt that the former price was too high.

We believe that it is conceded that Gale's Commutator Compound is to-day the cheapest and is in fact the only one that absolutely prevents sparking and cutting of commutators, at the same time putting a high gloss on the commutator without gumming the brushes and if the Electrical Engineer can find a single plant that has not yet tried Gale's, we shall be glad to furnish a sample free, upon application to their office, Marquette Building, Chicago.

ADVERTISERS' HINTS

THE U. S. ELECTRICAL SUPPLY CO., 120 Liberty street, New York, are selling incandescent lamps at 17 cents in barrel lots. Special prices to the trade.

AMERICAN RHEOSTAT CO., Milwaukee, Wis., state that their "Perfection" rheostat is the only one which has a double pole break and is operated by one movement.

ANCHOR ELECTRIC CO., 71 Federal street, Boston, Mass., have something to say of the springs used in their snap switches.

THOS. MUIR & SON, Detroit, Mich., have brought out a full new line of motor starters for elevators, pumps, hoists, cranes, etc.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia, Pa., publish a list of railways for which they have installed battery plants. They will have an exhibit at the convention.

THE PARTRIDGE CARBON CO., Sandusky, Ohio, advertise brushes of high conductivity that will not cut the armature.

CARLISLE & FINCH, 865 W. 6th street, Cincinnati, Ohio, manufacture some very interesting and instructive electric toys. They suggest their electric railway as an excellent Christmas present.

THE GARTON-DANIELS ELECTRIC CO., Keokuk, Ia., present a list of railways using their lightning arresters. The list is continually increasing.

RALPH VOSE, Hyde Park, Mass., is in the market to buy and sell all kinds of second hand testing instruments.

K. McLENNAN & CO., 1128 Marquette Building, Chicago, have reduced the price of Gale's commutator compound to 50 cents per stick and $5 per dozen. The excellence of this compound has been testified to by an innumerable list of users.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., advertise their standard portable and semi-portable instruments.

THE GLOBE GAS LIGHT COMPANY, 77 Union street, Boston, Mass., illustrate and describe the Globe blow torch, made entirely of copper and brass. They say it is extra strong, almost indestructible and specially adapted for soldering electric wires and other purposes where an intense heat is desired. They also advertise their No. 6 gasoline torch for outside work.

THE FOOS GAS ENGINE COMPANY, Springfield, Ohio, build gas and gasoline engines of from 2 to 250 h. p. and guarantee the close regulation of speed.

A. L. BOGART COMPANY, 50 East 20th street, New York, advertise gas lighting specialties.

E. H. KELLOGG & CO., 244 South street, New York, furnish the best grades of railway, dynamo, engine and ice machine oils. They have done so since 1858, and their oils are now world renowned. They will send a four-year calendar on application.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., say the Westinghouse electric railway system is the most durable, economical and efficient on the market.

THE WAGNER ELECTRIC & MANUFACTURING COMPANY, St. Louis, Mo., advise those interested to secure their latest prices on transformers.

HUGO REISINGER, 38 Beaver street, New York, claims the "Electra" carbons are unsurpassed for even and perfect combustion, producing the highest candle power in proportion to the current consumed.

THE WESTON ENGINE COMPANY, Painted Post, N. Y., build the "Imperial" self-oiling engines, and say of them: "They are the highest product of advanced engine building—a necessary and logical outgrowth of the demand for a clean and practical self-oiling engine."

HAROLD P. BROWN, 120 Liberty street, New York, publishes a record of tests of his plastic railbond, with a chart which speaks volumes for its economy.

THE STANDARD AIR-BRAKE COMPANY, 100 Broadway, New York, will exhibit their apparatus at the convention. They may be found midway between the exhibits of the Brill Company and the General Electric Company.

SCHIFF, JORDAN & CO., 232 Greenwich street, New York, advertise the celebrated "Ship" brand carbons, both cored and solid, for every kind of arc lamp.

THE VULCAN FOUNDRY CO., Pawtucket, R. I., are furnishing brass overhead electric railway equipments and supplies.

THE STANDARD PAINT CO., 81 John street, New York, continue to sell the P. & B. specialties, including ruberoid motor cloth, insulating tape, electrical compounds, and armature and field coil varnish.

I. P. FRINK, 551 Pearl street, New York, carries at all times a complete line of reflectors of such construction as to insure the highest efficiency. He will send price lists and estimates on application.

THE AMERICAN DISTRICT STEAM CO., Lockport, N. Y., offer some very logical suggestions to the central station manager with an eye to the gain and loss account.

THE WESTINGHOUSE MACHINE CO., Pittsburg, Pa., state that it is as much a part of their business to know what an engine will do before it goes into the hands of a customer, as it is to build it. By this arrangement a customer knows exactly what he is purchasing, and must be pleased.

JAS. S. BARRON & CO., 24 Hudson street, New York, recommend John Weldon's hand-made climbers.

THE INSTITUTE FOR HOME STUDY OF ENGINEERING, 73 Blackstone Building, Cleveland, Ohio, offer $50 worth of electrical apparatus, including a dynamo, to those subscribing to their course in electrical and mechanical engineering. They will send a 72 page catalogue on request.

McLEOD, WARD & CO., 27 Thames street, New York, advertise the Kinsman desk lamps and portables. They are a wonderful saving to the eyes.

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY, Cleveland, Ohio, are conducting complete courses in civil and mechanical engineering, advanced mathematics (including calculus), and elementary courses.

THE CREAGHEAD ENGINEERING CO., Cincinnati, Ohio, manufacturers of electric railway supplies, are advertising

mast arms, self-locking windlasses, and lamp hangers, construction material and the Creaghead flexible brackets.

F. M. LOCKE, Victor, N. Y., has introduced a new street railway insulator and steel pin. There is the best of material in both insulator and pin, and they are put together to stand the heaviest strains.

The C & C ELECTRIC CO., 140 Liberty street, New York, invite investigation of their latest multipolar dynamo. They claim it to be the perfection of dynamo design and construction.

E. P. ROBERTS, Osborn Bldg., Cleveland, Ohio, may be consulted on engineering matters.

W. H. BOWDLEAR & CO., 149 Pearl street, Boston, Mass., advertise the "Electrical" compound for insulating purposes. They say it is brilliant, elastic and sets quickly.

JNO. A. ROEBLING'S SONS CO. advertise the Columbia bond for electric railways.

THE GENERAL ELECTRIC CO. state that 32,200 G. E. railway motors have been manufactured and shipped by them since their incorporation. This represents an output of 849,000 h. p. They build railway motors ranging in sizes from 27 to 200 h. p.

THE ELWELL-PARKER ELECTRIC CO., Cleveland, Ohio, are building up-to-date multipolar generators, direct connected and belted, for a large variety of purposes.

THE CHICAGO FUSE WIRE & MFG. CO., 154 Lake street, Chicago, Ill., are introducing a most useful device in the shape of a fuse wire repair kit. The full size is 7 inches long by 1¼ inches diameter, and contains five sizes of fuse wire and an assortment of links. It is sold at $1.00.

CHAS. E. GREGORY CO., Chicago, Ill., the well-known dealers in dynamos, motors, lamps, instruments, supplies, etc., have found it necessary to increase their facilities for doing their large and constantly increasing business and will remove to 58, 60 and 62 S. Clinton street.

NEW YORK NOTES.

WESTERN UNION TELEGRAPH COMPANY has issued a little pamphlet all about cable rates.

COMMERCIAL ARC LAMP COMPANY has been formed in New York City, with a capital stock of $100,000.

THE GENERAL ELECTRIC CO. will make a highly representative exhibit at the Street Railway Convention, including all their latest novelties. The space selected occupies 1,100 square feet and there will be over 20 officials on the ground.

MR. J. H. ASTRUCK has resigned as manager and secretary of the Electric Arc Light Co. Mr. Astruck's present address is 15 Whitehall street, Room 33, New York.

MESSRS. GOLDMARK & WALLACE, 29 Chambers street, New York, have made a reduction in the price of their Koch woven wire dynamo brushes, without tubes. The reduction is only on the brushes without tubes. These were formerly sold at the same price as the brushes with tubes, on which there has been no change. The discount to consumers is 50 per cent. The object of the tubes in Koch brushes is to stiffen the brushes sufficiently to allow them to be used without guards. On brushes where guards are not objectionable they can now supply Koch brushes without tubes at much less than former prices. New price lists will be forwarded on application.

MR. EDWARD P. SHARP, 909 D. S. Morgan Building, Buffalo, N. Y., has already issued a very neat and useful pocket program of the American Street Railway Convention at Niagara Falls, October 19, and following days. It contains also a list of railway material for sale, and some curious data as to the number of different motors in use on 350 roads.

EDISON PHONOGRAPH OUTFITS and the various supplies necessary are described in an admirable pamphlet just issued by the Edison Manufacturing Company, of Orange, N. J. It illustrates and describes three types of machines marketed at $30, $75 and higher prices, including the home, exhibition, spring motor, commercial and other types. Several of the parts are also shown up in detail and the information throughout the book is of the fullest and most useful character. Note is also made of the Manual of the Edison Phonograph, which is invaluable to all users, and costs only $1.50. It will be understood that Mr. Edison's autograph is the trade mark of the concern, and that they handle for Mr. Edison the genuine article under the real name.

A. L. BOGART CO., 50 East 20th street, manufacturers of electric gas lighting specialties, are full up on orders and report having been very busy since September 1.

HUDSON RIVER TELEPHONE COMPANY has been putting up a 120-wire cable at Kingston, N. Y., under supervision of Messrs. J. A. Hyland and M. Walrath.

THE SPRAGUE ELEVATOR STRIKE is off after three months duration, and the Sprague shops at Watsessing are rushing things.

THE MICA INSULATOR COMPANY will exhibit at the Street Railway Convention at Niagara Falls from the 19th to 22d inclusive, a full line of their "Micanite" insulating specialties. During the past year they have added several new lines of insulating materials to their already extensive list, two of which may be mentioned, their flexible "Micanite" plate and "M. I. C." insulating compound. Their "Micanite" and "Empire" cloths and papers, together with "Micanite" plates for commutator segments, will be attractively displayed; and as the Company are manufacturers of commutator rings and segments to a very large extent, their exhibit promises to be one of unusual interest to all railway men in attendance. Mr. Franklin Brooks, vice-president of the Company, and Mr. Chas. E. Coleman, manager of the Chicago branch, will be in attendance and be pleased to welcome their many friends in the trade.

JUDSON A. GOODRICH COMPANY, of New York City, has been formed to deal in electrical apparatus, by C. L. Krekel, of Brooklyn; J. A. Goodrich and R. W. Hillman, of New York City. The capital stock is $10,000.

MR. H. B. COX, of the Cox Thermo-Electric Company, Ltd., arrived last week by the "St. Louis" from England.

THE MAINTENANCE COMPANY OF NEWARK, N. J., will conduct the manufacture and sale of machinery and electrical appliances in that city, and the capital stock is $100,000, of which $2,500 will be used to begin business with. The incorporators are: Joseph M. Cooper, of Orange; Louis Heck, of Newark, and James J. McKenna and Ernest R. Bartlett, of New York City.

MR. W. J. MORRISON, JR., has joined the forces of the Metallic Insulation Company, of New Brunswick, N. J.

MR. W. J. MANNING, who has been secretary to the commandants at the Navy Yard since 1861, resigned to become general manager of the Southern Electric Light and Power Company, Philadelphia.

NEW ENGLAND NOTES

AMERICAN ELECTRICAL WORKS, Providence, R. I., have just issued in magnificent style, broad-sheet, the group of participants in their Rhode Island clambake of 1897. It contains some 300 portraits of good-looking men at their best, and the names are keyed marginally. As a reproduction it is one of the best we have ever seen, and frames up handsomely.

STEEL SMOKE STACK WANTED. The Electric Light Commission of South Norwalk, Conn., are in the market for a brick lined steel smoke stack of about 500 h. p. capacity, including smoke connections, etc., to be erected at the city's electric light plant.

WHITE THERMOSTAT COMPANY, Providence, R. I., manufacturers of automatic fire alarms, combined with automatic sprinklers, are placing this apparatus in a large number of plants. Among the many now using White's automatic fire alarm system we mention United States Gutta-Percha Paint Company, Martin, Copeland & Co., both of Providence, R. I.; Chemnitz Co., Elmwood, R. I.; Dexter Yarn Company, Pawtucket, R. I.; Benedict & Burhham Manufacturing Company, Waterbury, Conn.

THE MUNSON BURMAH SLATE COMPANY, of Portland, Me., are sending out a handsome ebonized and plain paper weight as a sample of their slate for switchboards and other electrical purposes. They will take pleasure in sending one to any address on application. The company report an increased business in their electrical slate department and have recently booked a number of large orders from switch manufacturers and others in the electrical trade.

COMSTOCK, CHENEY & COMPANY, of Ivoryton, Conn., are erecting a fireproof building about 50 feet long. The side walls of this building are brick and the roof is constructed of iron. The covering is corrugated iron lined with the Berlin Iron Bridge Company's anti-condensation fireproof roof lining. The above company also are furnishing and erecting all of the steel work of the roof.

HON. G. C. SIMS, of the Vulcan Foundry, Providence, was in town last week. He reports his city as active in all lines, and finds the general outlook of trade excellent. Mr. Sims has quite recovered from the lameness due to his accident, and is in better health than for some time past.

TAUNTON LOCOMOTIVE WORKS are very busy at present turning out orders for snow plows for electric railways. A recent order booked by this concern was for eight double-

track share plows for the West End Street Railway Company. Boston, Mass. The Taunton Company has forty plows in process of construction and more than half of them are sold for early delivery.

THE ALLEGHENY COUNTY LIGHT COMPANY, Pittsburg, Pa., has recently installed four very large Westinghouse engines of the vertical compound-marine type, each driving Westinghouse two-phase 1,500 k. w. generators.

WESTERN NOTES

MR. J. G. HICKCOX, of the American Rheostat Co., of Milwaukee, Wis., was in the city this week, pointing out to his many friends in the electrical business the peculiar virtues of the American rheostat. Mr. Hickcox reports that his company is very busy at present, and that their factory is running nights to fill orders.

THE STRAWBERRY PICTURE sent out by the Western Electric Company is a peach, and we should be glad to have a pear of them. The title is, "Full Measure and Good Quality," and the subject is a basket of the luscious fruit, printed in several colors. Western Electric enclosed arc lamps are advertised on the back.

MR. JOHN C. FISH, the energetic secretary of the Shelby Electric Company of Shelby, O., was in New York City last week in the interests of their large and growing business in incandescent lamps. Their product is in such demand that the factory has been working night and day. Their lamps are made under the direction of Mr. A. A. Chaillet, whose experience in the field it would be hard to surpass.

PRESIDENT SAMUEL INSULL, of the Chicago Edison Company was in town last week on business of the National Electric Light Association. He stated that business had greatly improved in Chicago, and that in arc and incandescent lighting and in power work his company was much busier than last year. As to general conditions, all the manufacturing companies he is interested in are reporting much greater activity.

ST. LOUIS, MO.—The Electric Third Rail and Signal Company has been formed by B. C. Seaton, H. H. McElhiney, B. Eiseman and A. M. Sullivan, with a capital of $250,000, to introduce a combination electric railway system of conduit, third rail and overhead methods. The third rail is also arranged for block signaling on steam roads.

THE ELECTRIC APPLIANCE COMPANY report that the Midget long burning lamp is one of their most satisfactory specialties, as it sells on sight and always gives good results. In construction it is very simple, and in this lamp, at least, simplicity of construction means satisfactory operation. The Electric Appliance Company would be glad to send their new circular and make prices on application.

MR. W. R. PINCHARD, who is well and favorably known to the electrical fraternity in Chicago especially, having been connected with the city trade for about eight years, recently accepted a position as city salesman for the Electric Appliance Company.

SOUTHERN NOTES

U. S. COMR. BUTTERWORTH, of the Patent Office, has disbarred John Wedderburn and John Wedderburn & Company from practice in that department.

BALTIMORE.—The new Camden Station of the Baltimore & Ohio Railroad was opened for business October 10. It is practically an extension of the old Camden Station, which was built in 1857, and which for 40 years has been the principal passenger depot of the Baltimore & Ohio in Baltimore. The increase of business necessitated the erection of a train shed 630 feet long and 82 feet wide, with five tracks for the use of the local and suburban trains. This shed is constructed alongside of the "cut" that leads to the south portal of the Baltimore Belt Tunnel, and in the center of this "cut" has been erected a train shed 350 feet long and 42 feet wide for the exclusive use of the Royal Blue Line trains between Washington, Baltimore, Philadelphia and New York. These trains have hitherto backed in and out of Camden Station, but under the new arrangement will make but one stop at Camden. The passenger trains will be pulled through the tunnel by the 95-ton electric motors, thus eliminating entirely smoke from that tunnel. New waiting rooms, restaurant, ticket offices, etc., have been constructed, and, altogether, the new station is very roomy and exceedingly convenient. The improvements cost in the neighborhood of $100,000. The old station will be used for freight.

ELECTRIC STORAGE BATTERY CO., through Mr. W. W. Donaldson, of Baltimore, has sold a set of storage batteries to the county fire telegraph system, the current to be furnished by the Mt. Washington Electric Light and Power Co.

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Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. OCTOBER 21, 1897. No. 494.

ELECTRIC TRANSPORTATION

ELECTRIC CANAL HAULAGE IN FRANCE.

EXPERIMENTS looking to the haulage of canal boats in France have been carried on for some years past, several of which we have described. In 1892 MM. Denèfle, Papot, Gaillot and Brueder started in to solve this problem, and for this purpose a section of four kilometers length was assigned

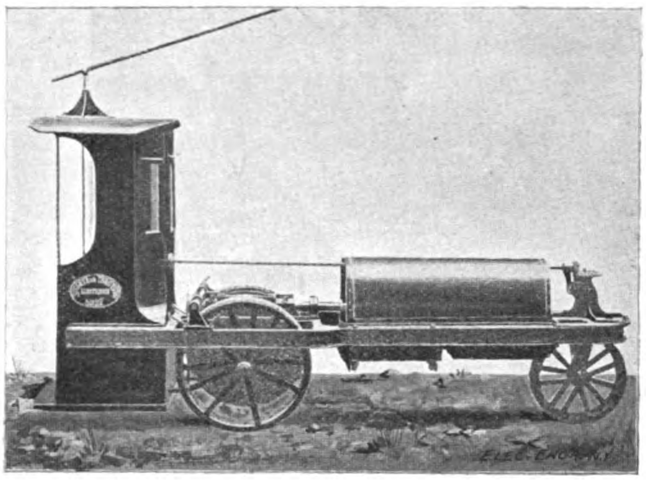

FIG. 1.—ELECTRIC "HORSE" FOR CANAL BOAT TOWING, FRANCE.

them in the Bourgogne Canal. These experiments resulted in a test made by the government in December, 1895, which turned out so well that the inventors are now equipping for actual work the Aire and Deule Canal, says l'Industrie Electrique.

The method employed by the inventors consists either in pulling the boat by an electric "horse," similar to a road locomotive, or to apply to each boat an individual motor, which drives the propeller. In both cases the current is obtained from overhead lines by means of a trolley. The electric "horse"

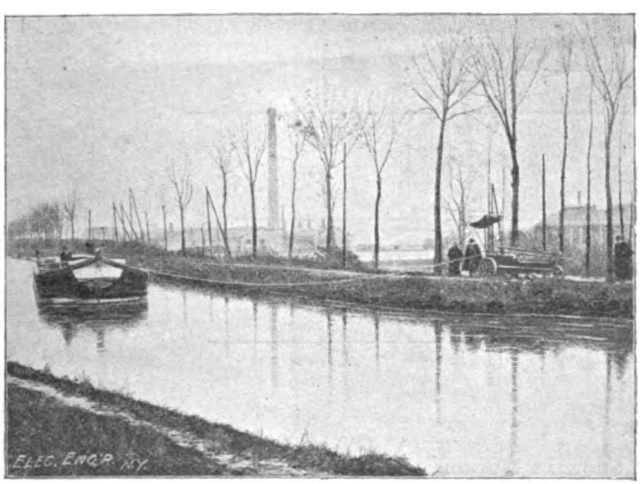

FIG. 2.—ELECTRIC "HORSE" TOWING CANAL BOAT, FRANCE.

is illustrated in the accompanying engraving, Fig. 1, while Fig. 2 shows it in operation hauling a boat. The locomotive carries a six kilowatt motor, geared to the axle of the large driving wheels, placed close to the cab. These driving wheels are of iron, and the rims are provided with blocks of aloe fibre, which gives the whole a certain elasticity and increases the adhesion. The cab contains the controlling apparatus, and has glass windows at the front. The brakes are operated by a pedal and the locomotive is steered by the front wheels, which are under control of the motorman, through bevel gears and the rod leading into the cab. The electric "horse" weighs altogether two tons, and is employed principally for the haulage of a train of boats. The other form of apparatus employed by the inventors is a so-called rudder propeller, which is shown in Fig. 3. This consists of a motor hermetically sealed, the shaft passing out through the rear for the attachment of the propeller screw, which has three blades, and makes 300 revolutions per minute. For this method of propulsion the ordinary rudder is removed and the electric propeller motor attached to the rudder post, as shown. This operation can be performed in a few minutes. The efficiency of the propeller is somewhat less than that of the electric "horse." The following are some of the results obtained by the two methods:

TESTS WITH THE "ELECTRIC HORSE."

Load.	Speed.	Power.
387 tonnes[1] ...	2km. per hour....	300v.—11.5 amp. = 3.45 k. w.
186 "	3km. per hour....	300v.— 6 amp. = 1.8 k. w.
No load	6km. per hour....	300v.— 3 amp. = 0.9 k. w.

TESTS WITH PROPELLER.

Load.	Speed.	Power.
186 tonnes	3km. per hour....	300v.—7.5 amp. = 2.25 k. w.

The propeller weighs 700 kilogrammes, including everything.

The installations now in course of construction on the canals of Aire correspond to the tonnage of 1895, that is 3,118,286 tons, corresponding to 11,000 loaded boats of 290 tons each, and

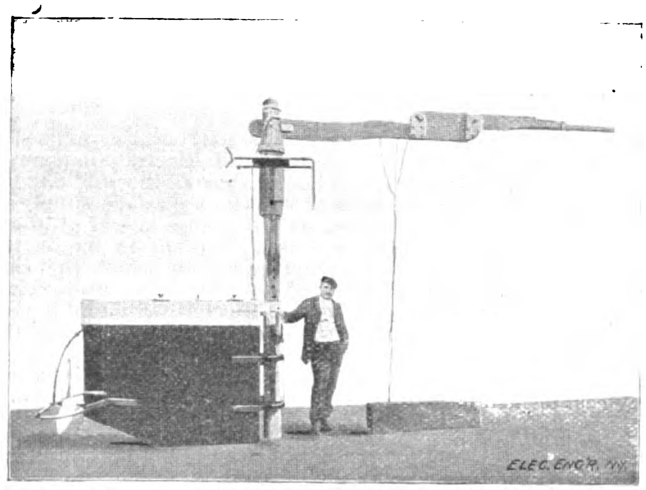

FIG. 3.—PORTABLE ELECTRIC PROPELLER FOR CANAL BOATS, FRANCE.

5,274 empty boats. Assuming rests and interruptions of service there would have to be handled every day 34 loaded boats and 16 empty ones, making a total of 50. The power necessary for hauling is calculated at 206 h. p., and making due allowances for losses, the generating stations are being equipped for 300 h. p. with a 100 h. p. unit in reserve. Two generating stations will be employed, one at Beuvry and the other at Bauvin. Current will be generated at 625 volts, which will give 500 volts at the end of the line. Returns will be made through the earth, with earth connections every 80 metres.

The cost of the first installation, one each at Beuvry and Bauvin, will be as follows: For ground, buildings, chimney, foundations, boilers, dynamos, etc., 122,750 frs., or for both, 245,500 frs. The line construction is estimated at 97,142.50 frs. Reconstruction of the roadway for crossing, etc., 46,482.50 frs. The cost of electric locomotives, controllers, traction cables, cranes, repair shops, etc., 310,875 frs. The total cost therefore would amount to about 700,000 frs., or, at the rate of 26,923 frs. per kilometre of canal. This figure is below that of similar electric haulage plants at Pouilly-sur-Saone, 27,800 frs.; Oder & Spree, 34,414 frs., and Saint-Maur and Saint-Maurice Canal, 28,846 frs.

The running expenses are estimated at 141,891 frs. per annum, of which 62,000 frs. are for salaries, and the remainder for expenses, fuel, repairs, office expenses and depreciation of 6½ per cent. on 700,000 frs.

[1]The French tonne, 2,200 pounds.

G. E. SURFACE CONTACT STREET RAILWAY SYSTEM.

THE occasion of the visit of Lord Kelvin to Schenectady was taken advantage of by the General Electric Company to make public the successful outcome of months of experiment on their surface contact electric railway system.

The experiments at Schenectady have been carried out upon a stretch of the track which forms part of the extensive factory tramway system of the General Electric Company's works. As the illustration, Fig. 1, shows, the addition to the roadbed between the rails of the track consists simply in two parallel rows of iron discs, convexed to a height of about one inch above the level of the rail. The car shown in the illustrataion is a simple factory tramcar to which the controller, motor and storage battery equipment have been fitted. It may be said here that the General Electric Company is now engaged in changing over to the surface contact system the entire trolley tramway system in its yards.

The main requirements in a surface contact system are four: Low cost of installation and maintenance; absolute absence of current from all discs not covered by the car; freedom from leakage of current, and reliability under all possible conditions of weather, service and location. It is the attempt to meet simultaneously all these requirements that has rendered the problem one of considerable difficulty, demanding long study and costly experiment to overcome. These requirements the General Electric Company claim are adequately complied with.

FIG. 1.—G. E. SURFACE CONTACT RAILWAY SYSTEM. VIEW IN YARDS OF GENERAL ELECTRIC CO.'S WORKS, SCHENECTADY, N. Y.

The only live portions of the G. E. surface contact system on the street surface are the contact plates immediately beneath the car. This is true whatever the position of the car and whatever the speed, each plate in turn communicating current to the motors and becoming inert as the contact shoe on the car leaves its surface. These contact plates are placed in parallel rows between the two rails of the track and are set alternately. In the illustration the positive or communicating discs are on the right, the negative or discharging discs are on the left, one of each between two of the others. Each positive contact plate is made alive by the operation of an automatic magnetic switch, which, instead of being placed in immediate juxtaposition with its plate, or opposite it outside the track, is placed in a manhole with a large number of others, each connected to its own respective plate. Through each negative plate is performed the double duty of closing the contact in the switch which "cuts in" the positive plate, and of receiving the return current from the motors. Fig. 2 shows the arrangement of the plates on the street surface.

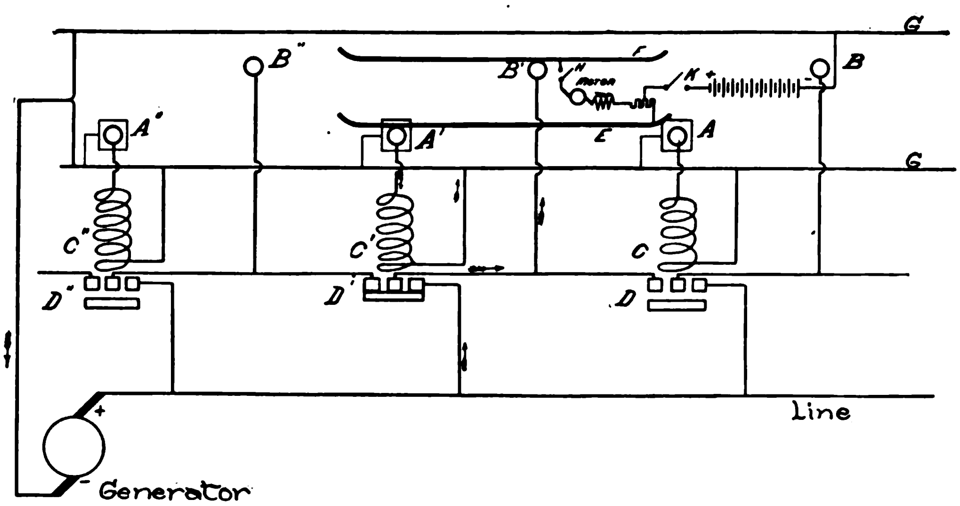

FIG. 3.—G. E. SURFACE CONTACT SYSTEM SHOWING METHOD OF OPERATION.

As will be seen in the accompanying diagram, Fig 3, A, A', A'' are the positive plates and B, B', B'' the negative. The positive contact plates are placed equal distances apart, a little less than one-half the over-all length of the shoe. C, C', C'' represent the automatic magnetic switches and D, D' and D'' their armatures or contact makers. F is the positive or collecting shoe; E the negative or return shoe and C the track return. H and K are switches which form part of the

controller, the latter connecting in, or cutting out, the cells of a small storage battery, which is used only to energize the coil of the first switch through the plate over which the car passes in starting. After the armature of the first switch has been raised into contact and the line current has completed its circuit, the battery is cut out by the forward movement of the controller handle.

In the diagram the car is to move to the right and all the magnetic switches are open. The handle of the controller is turned to the first notch and switches H and K are closed. Current from the battery flows through a small portion of the motor resistance to the shoe, thence to contact plate A and the coil C', completing the circuit to the ground. The coil C,' thus energized, raises the armature D', closes the circuit through the automatic switch and the line circuit completes its path through the motors and through the greater part of the motor starting resistance shown by the arrows, through the positive plate B and shoe F. Part of the return circuit goes to the storage cells, which are kept constantly charged, and part through shoe E, negative contact plate A' and coil C' to ground, keeping the latter coil energized and the automatic switch closed so long as the shoe remains on contact plate A'. Moving the controller handle forward from the first notch to the second notch opens the switch K, cuts out the battery and sends all the return current through the coil C'.

The shoes E and F in the diagram are a little longer than the distance between contact plates. Thus, when the car moves forward slightly, the shoe will be in contact with the two contact plates A and A' and the return circuit will divide, half going through coil C' and half through coil C, energizing both, and closing the armatures in the switches D' and D. The car moves forward and the shoe passes beyond the contact plate A'. The circuit in the coil C" is broken, the armature D" drops, cutting out entirely positive plate B", leaving it dead, but allowing B' still to receive current through the closed switch at D. Shoe F moving forward then makes contact with plate B before it leaves plate B', and the current is uninterrupted in its flow.

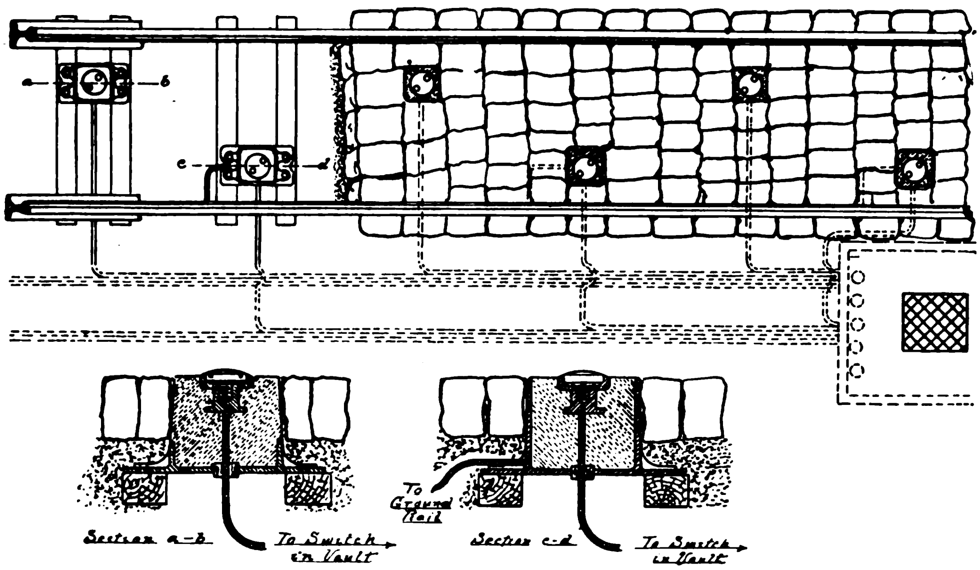

Fig. 2.—G. E. Surface Contact Railway System, Showing Surface of Street and Sections Through Positive and Negative Plates.

The automatic magnetic switch is the heart of this system. It has been designed to endure under the severest strains and to act with such uninterrupted precision that the working of the system may not be impaired. The development of this automatic magnetic switch marks a decided step forward. Mechanically the switch is simple, strong and durable, with all chances of derangement reduced to a minimum. In the course of the experiments this switch has been subjected to the roughest possible usage, and has withstood it unharmed.

If the leakage is great an arc is likely to form when the armature of the switch drops, and so long as this is held the contact plate in the street would remain alive, while the arc would burn the switch. As it is not practicable to allow the armature to drop far enough to break the arc, and, to extinguish it, the magnetic blowout principle is brought into play. By its use this retention of this arc is impossible. But there is also the possibility of another arc forming in case of accidental ground on one of the leads to the positive contact

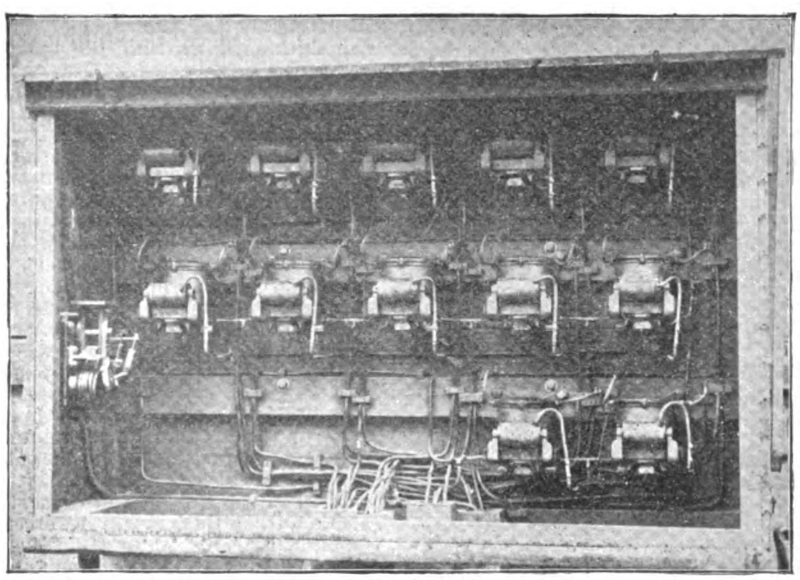

Fig 4.—G. E. Surface Contact System, Showing Automatic Magnetic Switches in Temporary Manhole.

plate, or if the forward switch fails to close when the handle of the controller is on the first notch, giving a path to ground through the battery. This is also taken care of by the magnetic blowout.

The form of the contact plates is shown in Fig 2. They are first set in iron boxes and then surrounded by insulation. The contact plates consist of two parts, a wearing piece screwed into a support and held by a spring washer. This wearing piece can be removed readily without disturbing the support. The standard shoe is thirteen feet long. Its shape and suspension is shown in the sketch, Fig. 5, the ends being curved upward slightly to prevent catching. The shoes are supported from the axles and have a slight upward and downward movement to allow for any irregularties in the height of the contact plates. The amount of drop in the shoe is regulated by a set screw.

The automatic magnetic switches are grouped in manholes, where inspection can readily be effected. Fig. 4 shows a group of these temporarily arranged for exhibition. Each manhole will contain about twenty switches, and the wires from the

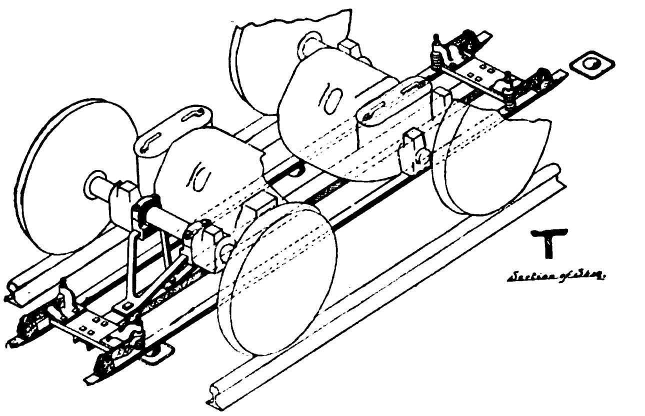

FIG. 5.—GENERAL ELECTRIC SURFACE CONTACT SYSTEM. SHOES ON CAR TRUCK.

contact plates to them will be protected in similar manner to underground wires for any other purpose.

The battery on the car consists of ten cells with normal capacity for 50 ampere hours at 5 amperes. It is equal to all emergencies, being called into requisition only momentarily, while being charged; the rest of the time the controller handle is on the first notch.

A close examination of the design and operation of this system will show that it possesses many striking advantages. The operation of the automatic switches is perfect under all conditions, as the full line voltage can be secured to close them and they open by gravity. There is no possible chance of the contact remaining charged electrically after the car has passed, as by the use of the blowout on the switch and the switch itself, which opens as soon as the current is shut off, all danger and trouble due to live contacts is eliminated. Grouping the switches in manholes renders the working part of the system easily accessible for inspection.

In the city of Monte Carlo, in the principality of Monaco, this system is being laid down by the Cie. Francaise Thomson-Houston, over a distance of about three miles. It is expected that this will be in operation very shortly.

ECONOMY IN ELECTRIC CAR CONTROL.[1]

BY J. R. CRAVATH.

LET us analyze the matter of electric car control and see where the losses through carelessness may occur. Frequent stops and starts make it possible in practice to waste power in several ways, principally by (1) Turning on current too rapidly in starting; (2) wasting an unnecessary amount of energy in the brakes.

The theoretical amount of energy required to accelerate a car from rest to a given speed is the same whether that power be applied to start the car quickly or slowly, but practically there are elements which enter into and modify this considerably.

The loss in the electrical conductors in the circuit (this includes power house generators, feeders, trolley lines, and ground return) varies according to the square of the current flowing. Thus the motorman who uses the heavy starting current even though he uses it for a proportionately shorter time, consumes more energy to get his car up to speed than the one who draws his power at a slower rate. For example, let the time of acceleration from zero to certain speed be 7 seconds, and the current used during that time 100 amperes. Then by the formula: watt seconds = (current)^2 x time in seconds x resistance (the resistance being assumed at .2 ohm, corresponding to 20 volts drop); the watt seconds lost in line and generator equals 14,000. If, however, a current of 50 amperes be drawn for 14 seconds through the same line to give the same acceleration, the loss is 7,000 watt seconds.

But this is only one item. When a car is equipped with series-parallel controllers according to the best and most general practice now, there is another chance for waste of power in starting by throwing motors in multiple before they have had opportunity to attain nearly their full speed when in series. When the motors are in series, the torque per ampere drawn from the line is double what it is when they are in multiple. Now it is torque per ampere that determines the efficiency of the motors as car accelerators. Consequently to get the full benefit of the efficiency of a series-parallel controller as a car accelerator, the full use must be made of the series combination of motors. Up to half speed the series-parallel controller affords a means of accelerating a car with but half the current required by a plain multiple controller, but if a motorman skips over the series points and into multiple with scarcely a pause he is throwing away half the power he uses during a part of the process of acceleration, and the car might as well be equipped with the old wasteful parallel controller.

Very many motor equipments now are provided with a shunt around the field coils, which is intended to be cut in to weaken the fields, to increase the speed after the full speed has been attained by the motors with fully excited fields. The common practice of motormen is to cut in this shunt when the motors are already groaning in an effort to start the car. Weakening the fields at such a time of course lowers the torque per ampere that can be obtained from the motors and consequently the efficiency.

It may also be mentioned that since the energy lost in heating the motors is proportional to the square of the current, the larger current used with the quicker start not only heats them more so as to endanger the insulation, but heats them so as to sometimes very materially lower their speed and efficiency.

It has been maintained by some that the resistance should be cut out as rapidly as possible in starting in order to avoid the loss of energy in the resistance. While it is true that it is possible to waste energy by continuing to keep in resistance after a car has attained speed on a point the unnecessary waste of energy in resistance during actual acceleration is more imaginary than real; first because it is hard to find a man who will keep it in too long, if the time table is as fast as it should be, and second, because a little mathematical calculation shows that the resistance introduced during acceleration is a necessary loss which cannot be eliminated by too rapid controller handling.

However, very slow controller handling is not to be recommended any more than very quick, because as soon as the car has responded to any one resistance point on a controller, the loss in the resistance begins. An exact analysis of this action is a complex mathematical problem which is not necessary to enter into here.

Before leaving the subject of losses liable to occur in acceleration, I must mention a mechanical loss, the slipping of wheels when starting. An electric motor gives such a steady torque that slipping of wheels is not very noticeable except by close observation. It is unnecessary to say that the energy so expended in wearing out wheels and rails does no good.

The opportunities for a motorman to save power by allowing the car to drift with current off, thereby using the energy stored up in the car at the time of acceleration are evident even to the layman. The amount of drifting he can do depends, of course, on the schedule and the traffic, but under conditions as they exist to-day, a great deal of energy is wasted in the brakes unnecessarily.

The author then briefly referred to the tests that have been made in various ways from time to time by different men, which demonstrate the opportunities for economy by a reform in the common methods of controller handling. The tests showed that the best results were obtained by working the controller so as to give as smooth an acceleration curve as possible.

A Chicago road, which is equipped with a device designed by the writer to check the use of excessive starting current by motormen, recently made a saving in coal of 15 to 20 per cent. for performing exactly the same service by the use of the instrument, and also reduced the maximum load at the power house about 25 per cent. This is the result of keeping an individual record of excessive current consumed by each

[1]Abstract of a paper read before the Chicago Electrical Association, October 1, 1897.

man and shows the difference between care and carelessness in controller handling.

Having discussed the scientific questions involved in economical controller handling, let us now see how a motorman should apply correct principles in the actual operation of a car over the road so as to get the best all around economical results. In the first place, in starting a car he should pause after each notch long enough to let the car run nearly up to speed on each notch. This does not mean that he should wait until he can detect absolutely no further increase in speed, but he should at least wait until he feels that the motors have responded to the movement of the controller. This will prevent slipping of wheels, jerking of passengers, and the use of excessive current. He should be especially careful not to throw from series to multiple until the motors have attained nearly their full series speed. He should also be careful not to move onto a field shunt point before the motors are speeded up on the previous one or he will waste power and strain armatures. He should always remember that the car should never be accelerated up to full speed when no time is to be gained by doing so.

For example, it is very common in city service to see a man run his car up to full speed just before coming to a team on the track, and then slowing up by hard braking just behind the team, and wait several seconds for it to clear the track. He gains no time by such a proceeding, and the energy used in running the car up to speed is immediately wasted in the brake shoes. In running up behind teams at full speed, when it is sure that they will not immediately clear the track, he should shut off current some distance back and let the car drift until nearly there. It is a good general rule to shut off current and drift with brakes off as long before making a stop as is consistent with the schedule time. It is a poor plan to make too gradual stops with the brakes. Let the car drift as long as possible, and then supply the brakes hard enough to make a moderately quick stop. In this way the high speed is maintained for a longer time than when the brakes are set very lightly for a long time, and consequently better time can be made with less power. On down grades use the current as little as possible. It will save work with the brakes and power also. All unnecessary stops should be avoided.

The author believes that the day is soon coming when its unquestioned economy will drive electric roads to the practice of keeping comparative records of the efficiency of each motorman just as such roads are being driven, by financial reasons, to keep many other records they did not dream of several years ago.

POWER DISTRIBUTION AND THE USE OF MULTIPHASE CURRENT TRANSMISSION FOR ORDINARY STREET RAILWAYS.[1]—I.

BY MAURICE HOOPES.

THE usual electric railway distribution system, with its copper network as one, and its iron network as the other half, offers rather more complicated problems than does the ordinary form of all-copper circuits. The latter system is symmetrical, whereas the former is likely to have greater resistance in the copper than in the iron portion. A rule that holds good of both systems is that the maximum benefit in reduction of total resistance, due to the addition of a given amount of conductor, results when the addition is made to the parts in which the drop is greatest per unit of length. An observance of this rule is important in adding to distribution systems. This demands a careful analysis of existing conditions. Before adding feed wire to a railway circuit, it is important to know the drops, under usual load, of the parts of the circuit. These may be found by the use of pressure wires, or by short circuiting the trolley wire to the rail, and passing a given current through the circuit, measuring the total drop and deducting the calculated overhead resistance from the total resistance thus found. Private telephone lines serve the purpose of pressure wires to measure track drops, and public lines connected through the exchange may be used without interference with the service. An exception to the general rule, that the copper should be added to the part of the circuit showing the greatest resistance is the case of a poorly bonded track that may show less resistance than the overhead. Reenforcing such track with overhead copper connected to each end of all special work may result in the greater decrease in the total resistance of the circuit. This is really a special application of the general rule, rather than an exception to it, however.

Means for regular and easy measurement of track joint drops should exist. For tracks having frequent high resistance joints, there is no better way than walking over it with a low reading voltmeter connected to prongs on the end of a stick, that it may be bridged across joints. For detecting poor joints in good track, where they are far apart and for the general inspection of the condition of track wiring, a car is convenient.

Where the ordinary methods of distribution are not applicable because of the prohibitive amount of copper necessary, some one of the following systems is commonly used to care for the particular section:

1. A "special generator" run at increased voltage and usually overcompounded as much as possible, handling the section and no other load.

2. A "booster," consisting of a series wound generator, connected in series with the feeder as it leaves the main station bus. The field turns of this generator should be such as to make the e. m. f. of the armature as nearly as is possible equal to the drop in the feeder, throughout all ranges of current.

3. The "three wire system." This requires the division of the section into two. One-half is then supplied from the regular bus, and the other from a special generator, with the polarity reversed, to bring the trolley wire opposite in potential to that of the rest of the system. The trolley wire should be so divided into the two half sections as to leave, as nearly as possible, equal loads on the two at all times. With this arrangement, the current in the track is only that flowing from the cars on one half section to those on the other. If these half sections are located near each other, this path through the track is very short. For this reason it is usual to make one track of a double track road one half and the other track the second half section. Unless conditions are such that the cars are likely to be bunched on one track this seems the better way of dividing. In addition to conducting current between cars, the track has to conduct back to the power station the excess in current used on one half section over that used on the other.

4. "The alternating current transmission system." The only form of alternating current system desirable for railroad work consists of high voltage, multiphase generators (or low voltage generators with step-up transformers) in the main station connected with one or more substations containing step-down and rotary transformers. There are some half dozen such systems in use in this country, of which the best known are those from Lowell to Nashua, and from the station of the Niagara Falls Power Company to Buffalo.

With any of the foregoing systems the storage battery may be applied as an auxiliary. In a railway power station, a battery is useful to the extent that it improves the station capacity and fuel economy by removing the immediate fluctuations. The writer considers that there are few instances where a battery can be installed, with resulting profit, where its function is the storing of power one hour for use the next. Except with very short time peaks, the battery costs as much as the additional generating apparatus. Particularly in small stations, however, there is such a variable load that it is impossible to average full load from the station for a period of time, because of the inability to handle the very great short time overloads that such an average load demands. In such a station a battery may result in considerable increase in station capacity, and by allowing the engines to operate at practically constant loads, reduce the fuel consumption greatly. While a battery may do these things in the station, it may do even more remote from the station. In the latter location, it will keep the potential near it practically constant, and will also maintain uniform current flow between the station and the particular point, thus adding the advantages of regulation and greatly increased copper efficiency.

One side of the story makes a pretty good case for the storage battery; unfortunately, the other must be told. The first cost of a battery is so very great that reasonable interest and depreciation on the amount invested will more than consume the apparent saving in many cases. Especially is this so in the case of a battery located on the line, where it has been shown that the gross saving is the greatest. This is true because it requires a very much larger investment in battery to care for the load variations of a given station if the batteries must be divided up among several substations, the load factor of each of which is necessarily lower than that of the main station. The sum of the maximum variations of the several stations is always greatly in excess of the maximum variations in the main station. If, however, a power station were to be located at a considerable distance from a single center of distribution through which all feeders from the station passed, it is quite probable that a battery placed at the latter point would result in a net saving, due to its giving each the station and copper a uniform load.

[1]Read before the Amer. St. R'way Assoc. at Niagara Falls. Abstract.

When it becomes necessary to select from the foregoing list the most suitable system for a given case, there are many conditions to consider in the decision. Either of the first three, the special generator, the booster or the three wire system may be arranged with the apparatus in any railway power station, assuming that it includes a reserve generator of the necessary size. It is better to use standard railway machines for these purposes and, if possible, to arrange the station so that any one of the regular station machines may be used. It frequently occurs that one or more sections of line fed from a certain station have copper enough leading to them to care for them properly at all times, excepting a few hours on each ordinary day, and for longer periods on heavy days. While the work may be quite variable at times of light load, when the load increases it becomes more nearly uniform. Such sections may be satisfactorily supplied over the copper designed for the lighter load, by raising the voltage on the station end of the feeder during heavy loads. Usually, the margin in the field rheostat will allow the increase of voltage on any one of the generators, to a point considerably above the normal. When this is not so, it is possible that the generator speed may be increased, unless limited by the requirements of safety in the driving engine.

In one or both of these ways it is often possible to get from 700 to 750 volts from a standard 550 volt machine. This increase enables the heavy load on the section to be handled very satisfactorily. The voltage at the feeder end necessarily varies with the load, and with ordinary fluctuations there may easily be 100 volts difference between the minimum and maximum. A recording voltmeter placed at the feeder end will show a very inky piece of paper after a run. In practice, on a line which the writer finds it necessary to handle in this way, he gets variations from 450 to 550 volts. The minimum is infrequent, however, and the schedule is made apparently as well as though the potential were absolutely uniform. Considering the question of abuse of apparatus, the increased voltage is not likely to injure a generator of modern construction. Practically, the only additional care that seems necessary is of the generator fields, noting that the increased current in the shunt windings does not heat them above safe temperature. So long as the potential at the car stays under 600 volts, there is little probability of trouble with equipment. Although the writer has had no such experience, he has known of cases where higher voltages have caused the arcs at controller contacts, when breaking, to jump to the iron frames. This difficulty has been experienced more particularly on small roads using boosters, where one car might constitute the entire load on the booster. At times of throwing off the power, the booster holds up its potential for a sufficient time to result in a very greatly increased voltage during the time of the controller opening.

The method just described has the advantage of simplicity and economy. Cases arise, however, when the very great fluctuations in load make its use impracticable. With a line which, at certain times, carries very heavy current, as compared with the average, there must be some means of automatically raising and lowering the voltage at the station end of the feeder to properly compensate for the variable drops. To accomplish this a booster is used. The system has the advantage of caring for extreme overloads on particular feeders, and is useful in cases where, for short periods of time, the feeder load is such as to cause excessive drops, and the time is not great enough to justify increased copper investment. On the other hand, it is expensive in operation, due to the fact that it wastes considerable energy, and that it generates this wasted energy in rather an extravagant way. If the booster is engine driven, the engine has widely fluctuating loads to handle, the load varying as the square of the current in the feeder. These variations necessarily result in a very low economy for the engine. With a motor driven booster, there are the constant losses of the two machines to meet. These are not so great as those of the engine and booster, but the necessity of keeping a particular generator for use as a booster limits the flexibility of the arrangement as compared with one which permits the use of any of the regular station generators, and, moreover, the addition of a motor booster does not increase the capacity of the station, as the power to drive the motor must come from the engines. The compounding of the standard types of railway generators is usually such that, when full load current is passed through them, the series turns alone will raise the fields to a point that will induce nearly normal e. m. f. in the armature. This adapts the machine for use as a booster on almost any line, excepting one requiring more than 100 per cent. increase of potential at times of full load. As lines when so overloaded would be much better provided for by the addition of more copper, they need not be considered. In most cases, it is necessary to cut down the e. m. f. of the standard generator in order to secure the proper ratio of e. m. f. to current for boosting, and this may be done by decreasing either its speed or the number of field turns. The former method has the advantage with an engine driven unit of improving the engine economy by lessening the friction losses and keeping the cut-off at a less wasteful point, whereas, the latter is the simpler way. To accomplish this, the writer uses a long German silver strip of sufficient section to carry the proportion of current that it is desired to shunt out of the fields. This strip is fastened to the generator frame, connected across the terminals of the series field, and doubled on itself in such a way that a clamp may be slid back or forth on it, raising or lowering its resistance. Knowing the resistance of the feeder upon which the machine is boosting, the clamp may be shifted to the point where the ratio between the reading of the voltmeter and ammeter is equal to the feeder resistance, and the proper adjustment reached.

APPLICATION OF THE STORAGE BATTERY TO ELECTRIC TRACTION.[1]—I.

BY CHARLES HEWITT.

The most important applications of the storage battery to electric traction are:

1. The application of the battery direct to car or locomotive. 2. The application of the battery at points on the line distant from the generating station. 3. The application of the battery in the power house.

THE APPLICATION OF THE BATTERY DIRECT TO CAR OR LOCOMOTIVE.

We are led to consider this form of application first, not on account of its successes, but rather on account of its conspicuous failures. From our investigation we can see nothing in this form of installation to commend, except for certain local conditions, which are peculiar to the large cities on the continent of Europe.

The first cost is greater than our present overhead form of construction, and the expense of operation is considerably greater; in fact, it is doubtful whether the expense of operation can be brought below that of horses. It is less reliable, and more objectionable to passengers on account of the gas given off. But very little reliable data are obtainable from all the various experiments which have been made. Most of such experiments, in this country, at least, have been made by battery manufacturers, and the results obtained have been most carefully guarded. Mr. Dawson, in an article published in "Engineering," October 16, 1896, says: "Two principal causes have so far prevented the successful use of accumulator cars; their great weight and rapid deteoriation of plant. Owing to these causes, the manufacturers of storage batteries only have seriously taken up accumulator traction, and although they have been working on the problem since 1880, little reliable information has ever reached the public."

In a paper read by the writer before the Engineers' Club, of Philadelphia, December 5, 1896, I gave in detail results of a test made by me of a certain battery car. The main results agreed quite closely with data which have come to us through European publications, and I feel confident in stating that the battery car requires considerably more power to operate than an ordinary trolley car of the same size and under the same conditions, and, further, the battery car will require a larger investment in generating machinery.

There is another phase of this method of application which is used somewhat extensively in Europe. In some of the larger cities on the continent there is a prescribed area within which overhead lines are not allowed to be erected. To overcome this difficulty the cars are supplied with batteries sufficiently large to propel them at a low rate of speed for a distance of three or four miles from the point where the overhead line ends, into the city and return. While the cars are completing the trip the batteries are charged from the overhead wire. I am sure such an arrangement would not commend itself to any practical railroad manager, except as a makeshift in such government ridden cities as exist in Europe.

The following data are taken from the writings of Mr. Dawson and others:

COMPARATIVE DATA OF ACCUMULATOR CARS.

	Paris Lead.	Berlin Lead.	Vienna Cop. Zinc.
Passengers carried	50	31	32
Empty car, weight in pounds	18,081	19,845	16,097
Loaded car, weight in pounds	25,799	24,630	21,036
Weight of cells	3,749	7,270	3,969
Number of cells	56	88	136
Capacity of cells in ampere hours.	230	130	300
Power per car mile required at power house in Board of Trade units	1,120	1,072	1,280

[1]Read before the Amer. St. Ry. Assoc. at Niagara Falls. Abstract.

DATA OF ACCUMULATOR CARS RUNNING IN PARIS.

Number of cells	108
Number of plates per cell	11
Size of plates, in inches	7⅞x7⅞
Thickness of negative plate, in inches	.236
Thickness of positive plate, in inches	.315
Weight of plates, in pounds	39.69
Capacity in ampere hours	250
Efficiency per cent.	70
Average discharge rate	35
Maximum discharge rate	100—200
Life of negative plate in car miles	93,750
Life of positive plate in car miles	8,750
Passengers carried	50
Weight of loaded car, in pounds	30,870
Weight of cells, in pounds	6,615

COST OF RUNNING ACCUMULATOR CARS IN BIRMINGHAM, ENGLAND, PER CAR MILE IN 1893.

	Pence.	Cents.
Wages	3.37	6.74
Fuel	1.76	3.52
Stores	.68	1.36
Water and gas	.12	,24
Sundries	.17	.34
Repairs and maintenance	5.49	10.98
Total	11.59	23.18
Car miles run		140,993

WORKING EXPENSES OF ACCUMULATOR TRACTION IN PARIS IN 1893, PER CAR MILE.

	Pence.	Cents.
General expenses	.204	.408
Cost of power	2,828	5.656
Maintenance and handling of accumulator	2,537	5.074
Motormen and assistants	1,210	2.420
Maintenance of motors and trucks	1.410	2.820
Heating, lighting and various	.138	.276
Total	8,327	16.654
Miles run		144,718

COMPARATIVE COST OF VARIOUS SYSTEMS OF TRACTION IN PARIS IN CENTS, PER CAR MILE.

	Cents.
Horses	17.10
Accumulator	16.66
Hot water locomotives	10.78
Overhead trolley system	9.24

A third phase of the battery car system is the battery locomotive. Aside from special forms such as the Heilman locomotive the one most worthy of mention is the experiment on the New York Elevated Railway, in which the battery is connected in multiple with the motors and charges or discharges according to the demands of the train. When the demand of the motors is sufficient to lower the pressure on the line to or below that of the battery, the battery will then discharge into the motors, thus relieving the feeders. When current is shut off from the motors, the battery will charge. No results of this experiment have been made public yet, but it is difficult to see how much is to be expected. It has the advantage of maintaining a fairly constant pressure at the motors, but this can be accomplished better in other ways, as I shall show later. It subjects the battery to usage which history has proved to be disastrous to its life and efficiency. In this method the extra weight of the battery has the certain advantage of giving additional adhesion to the rails. While not wishing to seem pessimistic, I must confess that to me the outlook for the battery car is not bright ,and I do not look for much improvement unless some combination of elements be discovered whose characteristics are entirely different from the lead battery.

STORAGE BATTERY TRACTION IN BERLIN.

The introduction of electric traction for the street railways of Berlin will probably be accomplished sooner than was anticipated. The parties in interest, that is, Siemens & Halske, the Grosse Berliner Pferdebahn, Charlottenburger Strassenbahn, Neue Berliner Omnibusgesellschaft and a new private company are prosecuting the work with zeal, and every week trial trips are made with new cars. The Grosse Berliner Pferdebahn have inaugurated a training school at their car house at Rixdorf, where the motormen are instructed in the operation of the cars, being made thoroughly conversant with the arrangement and the operation. Thus, there will be no lack of competent men to handle the cars when the change finally takes place.

On a number of long lines of the Grosse Berliner Pferdebahn the old rails have been taken up and heavier ones laid in their stead, adapted for electric traction, so that nothing stands in the way of the introduction of accumulator traction on those lines this fall. The building of the elevated electric roads is also going along rapidly. On the largest part of the Fitschiner Strasse the iron superstructure is already in position. In other places the foundation blocks for the columns are already in position. On the line of the Berlin-Charlottenburger Railroad through the Thiergarten special storage battery cars are already in regular operation.

THE BEST METHOD OF SETTLING DAMAGE CASES AND THE PREVENTION OF ACCIDENTS BY THE USE OF FENDERS OR OTHERWISE.[1]

BY WILLARD J. HIELD.

THE secret of success in handling damage cases lies, no doubt, in their being properly looked after from the start, i. e., at the time they are first reported. How to do this varies, as do the different cases, but no case should ever be handled by any one but an honest, careful and experienced claim agent. Every claim department should have a good system for securing reports of accidents, for obtaining evidence, and for keeping such files and records as may be necessary for its work.

The only accidents which demand serious consideration are those in which personal injury is involved. These may be divided into the three following classes:

First.—Those in which there is an undisputed liability and which, as a rule, should be settled as soon after their occurrence as possible.

Second.—Those in which there is a doubtful liability and which, generally, should be settled after careful investigation.

Third.—Those in which there is clearly no liability and which should therefore never be settled.

Frequently cases may prove exceptions to these rules, but in handling them under such a classification or any other, the following suggestions would seem to be of importance.

First.—It is of great value in every case to acquire a knowledge of it as early in its history as possible. Procrastination is ever dangerous and the claim agent should have for his motto, "Time is the essence of success."

Second.—Evidence should be carefully secured in every case soon after the accident. Too much can never be reported to the department, and what may seem of little importance at the time of the accident, may prove most valuable in preparing the case for trial.

Third.—In nearly all unsettled cases (particularly in serious ones), an examination by one or more surgeons in behalf of the company is desirable.

Fourth.—Assistance and kindly tender of services, immediately after a serious accident, are more in place than advances for settlement.

Fifth.—Admission of the company's negligence is seldom necessary, but the true rights of the claimant should not be denied; as by antagonizing him all chances of settlement may be lost.

Sixth.—Whenever possible, a sworn statement should be secured from the claimant, giving his history of the accident and stating as nearly as possible the damage done. Such an affidavit, carefully and truthfully drawn and signed before witnesses—who should also attest it—may often prove most valuable either in settling or fighting a case. By it the claims of the interested party are clearly defined and limited, so that any subsequent intention to change them may be checked.

Seventh.—In every case the claim agent should be fair, but firm. Too cheap a settlement is not the best settlement but one too expensive is quite as bad ,and perhaps worse. However, the claim agent can generally keep the claimant good natured and insist upon his acknowledging that the settlement was a fair one at the time it is made, and thus prevent his feeling or talking ugly about it later.

Eighth.—A full release of all claims should be taken from the claimant, and its contents explained to him fully. This is of great importance, as the validity of releases is often disputed, and it is then quite necessary to show that they were properly taken. On this account it is best to explain the release to the claimant before witnesses (who should also attest it) or to make him acknowledge later before them that he executed it of his own free will, understanding its nature.

The gist of the foregoing may be expressed in these few words: Have good claim agents of sound judgment, who will not settle cases by arbitrary rules, but who will rather consider them each in its peculiar details, weighing well the seriousness of the injury, the manner of the accident and hence the liability involved, as well as the circumstances of the claimant.

[1]Read before the Amer. St. Ry. Assoc. at Niagara Falls. Abstract.

The old saying that "an ounce of prevention is worth a pound of cure" was never better applied than to the accident features of a modern street railway system. The rapid transit now in vogue upon the busy thoroughfares of our cities whether by means of the trolley or the cable, has greatly increased the number of street railway accidents, and hence has caused the question, "How to avoid them?" to be of very serious interest.

For this purpose the following points seem to be of particular interest:

1. It is very important for the prevention of accidents, as before stated, that the operating and claim departments work in perfect harmony and unison with each other to this end.

2. The employing of none but good men is most essential, and having employed good men, it is quite important to keep them good in the fullest sense of the term.

3. Carefully drawn, explicit rules for operating cars made with due regard to the various local conditions should be rigidly enforced and intelligently observed.

4. Speed on various lines should be regulated according to the chances of accident presented.

5. Every car should be equipped with the best controlling apparatus, gong and headlight, and also be provided with such devices for the prevention of accidents as may seem practical.

By this last statement several good devices for the prevention of accidents are rather indefinitely referred to, among which the fender and the safety gate should be placed at the head. Experience has shown that the fender is seldom a nuisance and is frequently of great value.

The safety gate, with which all motor cars in Minneapolis and St. Paul are equipped, and which was not generally approved upon its introduction but a few seasons ago, has demonstrated its great value and practicability by almost annihilating those accidents which occur through boarding or alighting from cars. As the gate is operated by the motorman it should never be opened until the car is at a standstill, and should always be closed just before the power is applied for starting. After the public becomes accustomed to the safety gate, its operation demands no change of running time from that used before its introduction. The most timid, whether old or young, will walk without fear to the gate while the car is stopping, and thus take but little time to alight. The gate is also of great service in handling large crowds at the parks, where people seem to lose their common sense, as well as all ideas of propriety, and try to board and hang on to cars regardless of the danger involved. In such instances the value of but one entrance to the car is quite obvious, as at any moment the crowd may be checked by closing the gate and the car started.

Screens for the side of cars (when the trolley posts are between the tracks), sand boxes always filled with sand, and many other devices are also of considerable importance, and tend, each in its way, to reduce the number of accidents to the minimum. It is not possible, however, to operate cars entirely without accidents, and in studying the problem we should not look for perfect results.

MUNICIPAL OWNERSHIP AND OPERATION OF STREET RAILWAYS.[1]—I.

BY P. F. SULLIVAN.

The subject of this paper is one which cannot be treated properly or in other than a limited manner within the time and space permitted. What I shall write, therefore, is intended more to suggest lines along which others may follow rather than to attempt to treat it exhaustively.

The subject will be considered under the two following heads:

1. Municipal administration in American cities is so extravagant and unbusiness-like that in the interest of the public the powers and duties of municipalities should be reduced rather than be enlarged.

2. Municipal ownership and operation abroad are the exception rather than the rule, and were the reverse true, and such ownership and operation successful from a financial point of view, it does not follow that American cities could or should follow such examples, or that if they did so success would result.

As to whether we should experiment with socialism, particularly under our forms of municipal government while still going through the experimental stage, and as to whether popular government should compete with private enterprises, I leave for other and separate discussion.

MUNICIPAL MALADMINISTRATION.

Thoughtful men view with alarm the growth of American cities and the maladministration of their affairs; some go so far as to believe that both conditions seriously threaten the future of the republic. So alarming have these become that patriotic and thoughtful men, and women, too, have organized in nearly every city in the country with a view of arousing public opinion, of devising ways and means to purify local politics, and to obtain a fair return for money expended. In nearly every large city in every State in the Union, from Maine to California and from Oregon to Florida, such organizations exist under one name or another, and in some cities they go so far as to employ counsel and to instruct city governments in their duties. This is true of Boston, Providence, New York, Baltimore, New Orleans, Chicago, San Francisco and other cities. At the present time there are over fifty such organizations in existence.

The author then gives a series of abstracts from addresses by a number of prominent men at conferences of Good Government Clubs held in different cities during the past few years. The speakers from all over the country agreed on the low standard of ability and morals of municipal officeholders.

Under the conditions disclosed by these extracts—extracts, too, from American citizens, is it not strange that men will be found who will advocate enlarging the opportunities and powers of our city governments? Surely no business man would advocate it. On the contrary, he would have our municipalities conduct the business in hand in the same manner as the same business could be conducted by private enterprise before he would approve enlarging their powers and opportunities.

But the theorist says, enlarge the responsibilities of the government and you will improve it. Acting upon that theory the doors of every house of correction and penitentiary in the land should be opened and every evil-doer therein sent back to the community whence he came. He should then be restored to his former position in the community, and instead of looking after his conduct and affairs more closely he should be given carte blanche to do as he may wish.

OWNERSHIP AND OPERATION ABROAD.

According to the returns of street and road tramways to Parliament July, 1896, there were 153 distinct street railway undertakings in Great Britain and Ireland, subdivided as follows:

Number of companies owned and operated by private capital	116
Number of undertakings where tracks are constructed by the municipalities and leased to private parties	31
Number of undertakings owned and operated by the municipalities	6
Total	153

The six cities where the properties are owned and operated by the municipality are as follows:

	Population.	Miles of Track.
Glasgow and suburbs	840,000	73
Leeds	400,000	27
Sheffield	380,000	19
Huddersfield	100,000	21
Plymouth	90,000	5
Blackpool	35,000	5
Total miles of track		150

GLASGOW.—Of the above cities Glasgow is the only one wherein the undertaking may fairly be called successful. And with reasonable economy it could not well be otherwise than financially successful. For a population of over 800,000 Glasgow has only seventy-three miles of tracks, whereas St. Louis, with a population of less than 700,000, has over 335 miles of tracks. It does not follow, therefore, that if the government of St. Louis was conducted equally as well as the government of Glasgow, that it could also operate the street railway system of that city successfully financially.

It is well to remember, however, that Glasgow boasts of a "Continuity of existence of over nine centuries." We may, therefore, safely place it within the limits of possibility that when our American cities survive a "Continuity of over nine centuries" that they may be so far advanced in methods and morals that they, too, may be intrusted with additional power and responsibilities.

LEEDS.—The city of Leeds had operated its street car system for nearly three years. The first year showed net earnings of approximately \$15,000, less than 1 per cent. upon the capital invested, whereas private capital earned and paid 7 per cent. the previous year. The second year showed a net profit of \$35,000, not quite the interest upon the sinking fund. And such results, too, with a population of nearly 15,000 per mile of track.

SHEFFIELD.—Previous to the acquisition of the street railway by the municipality, July, 1896, private capital received from 5 per cent. to 8 per cent. dividends from the operation of the property. Under municipal management there was a loss

[1]Read before the Amer. St. Ry. Assoc. at Niagara Falls. Abstract.

the first year, the property not even earning the interest upon the capital invested. And such results in a city which has over 17,000 persons per mile of track.

HUDDERSFIELD.—This was the first city in England to attempt the operation of its street railway, and for the fourteen years which it has operated the property there has been a loss of $311,000, varying from $3,300 to $83,000 in a single year.

This loss has been met by drawing $105,000 from depreciation account and the balance by taxation, varying from one-ninth of a penny to 5 pence per pound. It may seem strange that the municipality should thus continue to operate under such conditions. The fact is that Huddersfield is a manufacturing city and the non-property and small tax-paying voters are in a majority.

PLYMOUTH.—In the last fiscal year there was a loss of $5,430. This city did not acquire the property voluntarily. On the contrary, the operating Company intentionally forfeited its charter and abandoned the operation of cars.

BLACKPOOL.—This operation shows a net profit for four years of $992 after paying interest and charging off to depreciation.

And yet in Plymouth, Huddersfield, Sheffield and other cities in England, boys from 14 to 16 years of age, receiving $2.50 per week, are employed as conductors. Notwithstanding suc h conditions, some of those cities have not earned the interest upon the capital invested. Does any one suppose that American cities if operating street railways could employ such conductors at such rate of wages? In Germany there are only three cities which own and operate their street railway systems, and two which own the tracks and lease them to operating companies. In France, none.

The facts as they are before us are that there are few cities abroad which own and operate their street railway systems with more or less indifferent results, and only one of which, viz., Glasgow, which can properly be called a financial success; and yet there are those who would have American cities, regardless of the differences of conditions and institutions, plunge blindly into the acquisition and operation of 15,-000 miles of street railway tracks because Glasgow operates 73 miles successfully.

It seems to me that those who honestly advocate the acquisition and operation of street railways by municipalities do not look below the surface. They find that an occasional city abroad does such things and they immediately jump to the conclusion that we should do likewise. They do not study the conditions with respect to accommodations furnished abroad as compared with those in this country; the methods of administration there compared with these here, and the civil service abroad compared with ours.

LETTERS TO THE EDITOR

THE DETROIT MUNICIPAL LIGHTING FIGURES.

I HAVE read the editorial in The Electrical Engineer of October 7 and have asked Mr. Starring, our secretary, to look it over and give you his impressions of it.

I have never claimed that we could light Detroit as cheaply as many experts have said. My figure for an arc lamp has always been $100. The advantage we have gained by having our own plant is not so much in the price of the light as in the quality of it. During all the years that light was furnished by the Brush and Detroit Electric Light and Power Company we never had a month's good lighting; now the city is so well lighted that I never hear a complaint. The lamps burn steadily and continuously and the light is perfect.

As to cost, there isn't any question in my mind that that has been larger than it will be in the future. We have only now finished the installation of the plant and it has cost us more to run it than it will from now on.

I am more than ever in favor of municipal ownership of lighting plants and believe that any city of the size of Detroit can make its own light at a less price and give more satisfactory service than would be obtained from a private corporation. A less expensive plant might have been built, but we felt there wasn't anything too good for Detroit.

I enclose a letter received to-day from Mr. Ford Starring, secretary of the Public Lighting Commission.

J. L. HUDSON,
President Public Lighting Commission.
Detroit, Mich., October 14, 1897.

Hon. J. L. Hudson, President Public Lighting Commission, City:

Dear Sir:—I have your esteemed favor, with editorial from The Electrical Engineer.

The only criticism that The Electrical Engineer has to make in connection with the costs of an arc light, as per the second annual report of your Commission, is that it does not think a sufficient amount was allowed for the depreciation of the property and that no charge appears for insurance.

As to the insurance, no insurance is carried, as the construction and arrangement of the buildings is such as to reduce the fire risk to a minimum, while the arrangement of fire extinguishing apparatus and the precautions against fire are the best possible.

As to the depreciation, The Engineer asks if "a conservative business man would lull himself into the belief that keeping his apparatus in good repair could stave off indefinitely the day when entire renewal will become necessary, either from the inevitable wearing out of the apparatus, or from the necessity for replacing it by other apparatus of improved or more economical character."

I believe that it is possible to so keep property, such as is inventoried by your Commission, in such repair that it will be everlasting. The old farmer always had his jack knife, though he renewed successively the blades, the handle, the springs and the pins. Twenty-five years from now your machinery will be still in operation, unless destroyed by some unusual cause, though its parts may not be the identical parts that are now in use. The boilers were the only part of your property which could not be repaired from time to time, and which at some future day will have to be entirely replaced.

As to the replacing of the machinery for an improved system, in that event the loss would not be chargeable to the present operating, but to the future expense and would enter into the cost of the new system to be then adopted.

As to the cost of your arc lights as compared with what the city was getting under the contract system, I would call your attention to this: The best offer the City of Detroit had from corporations, before it undertook lighting itself, was $100 per arc lamp per year on a ten-year contract. The quality of the light that was given the city under the contract system was as low, at times, as that produced from 7 amperes of current, while it did not average better than from about 8 amperes of current. The light as produced by the city management is constantly from 9.6 amperes of current. Comparative costs should, then, to be correct, be considered with reference to the relative amount of current.

Furthermore, I would call your attention to page 29 of your report, which shows that during the last three months of contract lighting 1½ per cent. of the lamp hours were reported "out," while under the municipal management the "outs" have grown so small as to be too little to enter into computation.

As to the minimum of cost having been reached for an arc light by the Detroit plant, your Commission states on page 14 of your last report that "from now on the operating alone will command attention and the problem of cheap electricity given undivided consideration." Your output this present year will be increased about 12½ per cent., while the increase in the investment and in the cost of operating will be slight.

I do not believe a corporation would care to contract to give the City of Detroit as good service and as good light as it is now getting for less than about $125 per arc light per year.

I have the honor to be,
Yours respectfully,
FORD STARRING, Secretary.
Detroit, Mich., October 14, 1897.

THE ETIQUETTE OF ANONYMOUS DISCUSSION.

PERMIT me to apologize through your columns to Mr. Wm. Mayo Venable, inspector Cincinnati Underwriters' Association, and others of your contributors for having replied, in my communication published on September 9, to Mr. Venable's letter which appeared in your issue of August 12 last, and for having violated in so replying one of the most firmly established, although unwritten, rules of journalism, which prescribes that contributors to a discussion commenced under a nom de plume, shall not in the continuance of the discussion reveal their identity, and that writers shall not recognize any communincation from a subscriber who fails to comply with this rule.

My desire to have the subject of iron conduits discussed entirely on its own merits, without the identity of the writers being considered, and the further desire to avoid personalities, constituted my only reasons for opening and continuing the discussion as JIM CROW.

TROLLEY CAR AMBULANCES are to be introduced in the city of Pittsburg, running independently over all the street car tracks as called for.

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DETROIT MUNICIPAL LIGHTING FIGURES.

IN our issue of October 7 we had occasion to comment on the Second Annual Report of the Detroit Lighting Commission, in which are given the figures for the operation of the city's lighting plant during its second year of operation. According to the figures of the Commission itself, it costs the city $89.42 per arc lamp per year, an increase of a trifle over $2 per lamp over the year preceding. We were glad to note at the time, and commended the Commission for its fairness in including in the cost per arc lamp the items of interest, taxes and depreciation. We took occasion, however, to point out what seemed to us an oversight on the part of the Commission in limiting the depreciation to that on the boilers alone, while all other parts of the plant, including buildings, machinery, lamps and dynamos, were not included in the depreciation account. It was also pointed out that no item of insurance on the plant was included. Taking these points into consideration, and basing our calculations on the cost of plant, etc., given by the Commission, we figured that, assuming 5 per cent. to cover depreciation and interest, the actual cost per arc lamp would aggregate $102.49, while, if assuming only 3 per cent., the cost would still be brought up to $97.26.

We are glad to note that our comments on the Detroit plant have been taken up by the Detroit Lighting Commission and on another page we print letters on the subject from Mr. J. L. Hudson, president, and Mr. Ford Starring, secretary of the Commission. There are several points in these letters which we would like to dwell on. Mr. Hudson, it will be noted, is frank enough to admit that he has never claimed that Detroit could be lighted as cheaply as had been asserted by many experts. His own figure for an arc lamp, he states, has always been $100. But possibly the most significant point in Mr. Hudson's letter is that he avers that the advantage gained by Detroit having its own plant lies not so much in the price of light as in the quality of it! This assertion is supported by the statement of Secretary Starring that during the last three months of contract lighting 1½ per cent. of the lamp hours were reported "out," while under the municipal management the "outs" have grown too small to enter into computation. We cannot too strongly impress upon electric lighting companies the moral to be drawn from this brief but pregnant statement. It certainly ought to be the aim of every electric lighting company to exert every possible effort to insure the steady burning of its street lights. It is bad enough to have complaints from private customers as to the quality of lighting, but the prestige of a company is injured far more by an arc lamp out on the street, where the failure is observed by thousands, than would be a dozen "outs" in private establishments. We hope that this point will not be lost upon electric lighting companies, for, as shown by Mr. Hudson, it is the quality of the light furnished the city which to him appears the greatest advantage in the city owning its plant.

As regards the points made in the letter of the secretary of the Detroit Lighting Commission, in answer to our criticisms regarding insurance, we can only say that the differences of opinion between us seem to be so radical as to be almost irreconcilable. According to Mr. Starring: "No insurance is carried at Detroit, on the assumption that the construction and arrangement of the buildings is such as to reduce the fire risk to a minimum, while the arrangement of fire extinguishing apparatus and the precautions against fire are the best possible." As to this, we can only say that the Detroit Commission has less respect for fire and for precedent than we have. While proper construction and precautions can, and do, reduce the fire hazard, we have never come across any one whose opinion is entitled to any consideration who considered that any electric light station thus far built was absolutely fireproof. Absolute fireproofness, indeed, is probably unattainable anywhere, as has been only too often proved in the past, while as regards electric light stations we believe its assumption carries with it faith in the efficacy of fire-proof construction and fire defense that almost approaches fanaticism. We can only say on this point that we hope the Commission may not be rudely awakened from its dream of security.

As to depreciation, the secretary of the Commission takes the ground that a piece of apparatus can be indefinitely repaired, and, indeed, to use his own expression, made everlasting. The story of the man who always had his original jack knife, though the blades, handle and springs, etc., were frequently renewed, is, however, not as applicable to the case as might appear at first sight. When it comes to the ordinary small repairs to which a piece of machinery is subject, such as the lining of a bearing, or the replacing of a burnt-out coil, those items cut no great figure, but when, after a lapse of time, a general disintegration takes place, requiring the substitution of an entire part of the machinery, then the question of repairs assumes quite a different aspect. Thus, while in the early life of a piece of apparatus the repairs may be small, they may later on amount to such a sum as to involve a considerable percentage of the original cost of the machine. This is the item for which depreciation is charged, and which the Commission, as pointed out above, seems to have ignored entirely. The naive remark of Mr. Starring that "the boilers are the only part of the property which could not be repaired from time to time, and which at some future day will have to be entirely replaced," would seem to indicate that its writer is in blissful ignorance of the cost of boiler repairs, which, as every engineer knows, is probably greater than that of any other part of the mechanical equipment of an electric light station. Indeed, we have known instances where the cost of repair of boilers per annum has reached nearly 10 per cent. of their first cost.

As to the replacing of old machinery for an improved system, in that event, says Mr. Starring, "the loss would not be chargeable to the present operating, but to the future expense, and would enter into the cost of the new system to be then adopted." If we understand this rightly it means that when the time comes for the renewal of machinery, in the true sense of the word, that is, the casting away of the old, worked-out and the adoption of the new and more efficient, it would require an able-bodied appropriation. Will this appropriation come under the head of operating expenses? Certainly not, because it is an investment, pure and simple. Whether it be paid twenty years hence, or to-day, evidently does not change

the nature of the expenditure, and this is one of the main points which has been urged, and we believe rightly, against the operating by municipalities of public franchises, such as electric lighting. The cost of constantly keeping up to date is such an indefinite item, and especially so in electrical work, that no one can tell what it is or what an electric light station will look like twenty years from to-day. As a living example of this we need only cite the case of the Philadelphia Gas Trust, which is operating apparatus installed a quarter of a century ago and longer, and which it is needless to say cannot begin to compete in economy with a modern gas works. Of course, if a municipality is content to work on indefinitely with the old apparatus which it possesses, well and good, but to figure as operating expenses the cost of installing improved apparatus is very bad bookkeeping, to say the least.

Just one point more with reference to the contents of the letter from the president of the Detroit Public Lighting Commission. Mr. Hudson states that the plant has hitherto cost more to run than it will from now on, since the installation has just been finished. If this assumption be correct, how can it be explained that during the second year of the operation of the plant, still unfinished, the cost per lamp, according to the Commission's own figures, is greater than the cost during the first year? Would it not be fair to assume that during the first year, during which time things may not have been in the best running order, the cost would have been higher than in the second year, when a greater degree of order had been established in the operation of the plant? We do not insist on this point, but it strikes us as curious in the light of the figures before us, and we sincerely hope that Mr. Hudson's predictions may be realized.

The letters from the Detroit Commission ought to be carefully studied by all central station men. There is a moral, and a valuable one, to be drawn from them, and that is—as we have said before, and which cannot be too often repeated—that a high standard in the operating department and a satisfied public are a powerful prophylactic against the municipal ownership fever. We might also suggest to this an addition, and that is, a study of the rates of charge to private consumers and their readjustment, where necessary, on a basis more rational than seems to be the case in many cities.

ECHOES OF THE CONVENTION.

THE Niagara meeting of the American Street Railway Association must be commended as perhaps the largest and best convention ever held by that body. Each year has seemed to set a higher mark in number and quality of attendance, and now we see a gathering with at least 1,200 to 1,400 people present. Such a convention in any industry is impressive, and it may be doubted whether an equal to it can be found. One of these days, the electric lighitng conventions will equal it, but in the meantime the adoption of the all-conquering trolley has lifted the street railway industry on to a plane of progress and proseprity that make it the envy of other branches where the advance has been less rapid and brilliant.

We may expect to see the industry go on, but it is evident that new fields are needed. All the great cities are now trolleyed or subtrolleyed, and New York at last closes the procession by falling in line. Extensions there will be and renewals, but for bulk of business those interested in the art are turning their eyes to elevated roads, suburban traffic and the conversion of various steam lines. The Walker and General Electric equipments for such work stood forth in the great exhibition like fingerposts of prophecy, and the remarkable testimony of Col. Heft clinched with affirmation many of the arguments for the change that have been put forward by electrical advocates. Possibly the transformation will be slow. Some of the defenders of steam die hard. But will not the change assuredly come?

Although the papers read at the convention were few in number, they all treated of topics of vital interest to electric railway men. The best method of power transmission on railway lines, discussed by Mr. Hoopes, is a question which has probably been brought prominently to the consideration of not a few railway managers, who have found that their present heavy investment in copper is in many cases inadequate. Mr. Hoopes is evidently impressed with the desirability of sticking to the direct current as much as possible and of utilizing the means at the hand of the electrical engineer for increasing the potential, though he does not deny the utility of the alternating current in special cases.

As regards the use of the storage battery in traction work Mr. Hoopes seems to be of the opinion that this auxiliary shows to best advantage only in small power stations or at the ends of long feeders. Mr. Hewitt, as does Mr. Hoopes, prefers to have the battery at the end of long feeders, to maintain the potential, but nevertheless does not deny their utility in power stations. Still, even granting such a limitation, American storage battery manufacturers will find their hands full for a long time to come to supply the demands of those companies who aim to operate their systems with some degree of constancy of potential at the outlying points in their systems. It will evidently make little difference to the storage battery maker at which end of the line the battery is placed. The work already accomplished in this direction has given such gratifying results and the economy, as pointed out by Mr. Hewitt, is so apparent that the future of the storage battery in railway work may be considered to be assured.

Now that municipal ownership of public franchises has become the slogan of local politicians all over the country, a paper treating on the subject as related to street railway operation is eminently timely, and Mr. P. F. Sullivan deserves the thanks of the entire community for the clear and dispassionate manner in which he handled his chosen topic.

We have had the ownership of railways by foreign municipalities dinned into our ears for months and Glasgow particularly held up as a model. And what does Mr. Sullivan show to be the facts? In the first place, that municipal ownership abroad is the rare exception, and not the rule and that Glasgow alone of all the cities in Great Britain may be said to be fairly successful. But when it comes to comparing the relative conditions of mileage per unit of area, service rendered, etc., we believe even the advocates of municipal ownership will recognize that the conditions are so unlike that no foreign railways can be taken as a criterion for American practice. Just imagine boys 14 and 16 years of age acting as conductors on our cars, at the princely salary of $2.50 per week. The mere suggestion of such a thing is appalling to one's sense of right and duty to the public; and yet that is the practice on several municipally owned street railways in England! We might go on quoting from Mr. Sullivan's admirable paper, but must refer the reader to the paper itself as containing some of the best facts and arguments against municipal ownership which have come under our notice.

That ever present question of proper discipline of employés, a usually boring topic, had a good deal of life instilled into it at the hands of Mr. Davis. This gentleman is a thorough believer in the competitive civil service method of handling men and he certainly made out a very good case. It may seem a waste of time and a getting of things "down too fine" to keep continuous tab on a man, but in a large system, where the general manager cannot keep every individual employé under his personal supervision, we know of no other way in which he can gain the knowledge indispensable to a correct estimate of an employé's fitness for his present position or for promotion. We believe that if more of this were done one would hear of fewer accidents than is the case at present, not to speak of other things, such as economies in the proper handling of apparatus, both in the station and on the cars. Taken altogether the half dozen papers ought to furnish food for thought for some time to come to the members of the association.

SIXTEENTH ANNUAL MEETING OF THE AMERICAN STREET RAILWAY ASSOCIATION.

THE sixteenth annual meeting of the American Street Railway Association was held at the Armory, Niagara Falls, New York, October, 19-22, 1897.

President Robert McCulloch, of St. Louis, called the meeting to order at 11 o'clock Tuesday morning.

On the platform were seated ex-Presidents H. H. Litell, Henry M. Watson, H. M. Littell and George B. Kerper. The officers and members of the Executive Committee were also seated on the platform as follows: Messrs. Charles S. Sergeant, D. B. Dyer, C. F. Holmes, H. P. Bradford, Charles H. Smith and the secretary, Mr. T. C. Penington, of Chicago.

Hon. A. C. Hastings, mayor of Niagara Falls, welcomed the convention.

The following companies acquired membership in the association: Nassau Electric Railroad Company, Brooklyn, N. Y.; Binghamton Railroad Company, Binghamton, N. Y.; Buffalo Traction Company, Buffalo, N. Y.; Roxborough, Chestnut Hill & Norristown Railway Company, Philadelphia, Pa.; Chester Traction Company, Chester, Pa.; Colorado Springs Rapid Transit Company, Colorado Springs, Col.; Southwest Missouri Electric Railway Company, Webb City, Mo.; Union Traction Company, Anderson, Ind.; Atlanta Railway Company, Atlanta, Ga.; Wakefield & Stoneham Street Railway Company, Boston, Mass.; Mystic Valley Railway Company, Boston, Mass.

President McCulloch then read his address and the secretary and treasurer's reports were presented.

MR. McCULLOCH said:

Our convention assembly for the sixteenth annual period is within the sound of nature's greatest wonder, but the wonders that are wrought in our own immediate application and appropriation of nature's resources are even more startling and awe-inspiring than the great Niagara Cataract. The enabling element for the utilization of this wasted energy of the past is electricity, in the development and search for uses of which the scientist and manufacturer sleep not, neither do they rest. They furnish us with their best and latest devices and appliances to-day, and to-morrow these are obsolete. To keep our place in the procession we must join in the cry of "The King is Dead, Long Live the King." We must discard the old and adopt the new, or else be ground under the wheels of this juggernaut of progress. Unfortunately, if we endeavor to "shun Scylla, we are in danger of being wrecked on Charybdis;" hence we assemble here to counsel together as to how we may best shape our course. To learn more of this revolutionary factor in our business, to discuss this and other kindred subjects, to compare our experiences, to meet and greet each other, to renew old friendships and acquaintance, and to form new ties, to be forced, if need be, to recognize that "there are other pebbles," to find that the American Street Railway Association is filled with men to know whom is both an honor and a pleasure—these, my friends, are some of the things which have brought us together, and it is hoped that a full measure of pleasure and profit will reward all who honor us with their presence.

Our noble ally, our helper in all the good work we accomplish, our always alert, jovial and genial friend, the supply man, has contributed, as usual, his share to our entertainment and enlightenment. He is here to show us the best of everything he has. He is not, in one sense, a member of our association; he does not participate in our deliberations, but he stands at our threshold, and the vigilance which he exercises, that none may escape, is worthy of our emulation in the conduct of our business. Let us show our appreciation of his efforts by inspecting his wares, by loading him with orders and by fraternizing with him, that his enjoyment of the occasion may be equal with ours.

We have still another and a new element in our gathering for this year. Whilst we are here engaged in the discussion of questions pertaining to the construction, equipment and operation of the roads and interests in our keeping, there is assembled near by, and also in deliberate convention, an earnest, intelligent, enthusiastic body of mostly younger men than ourselves. They have in view the same objects which bring us together—a betterment in the performance of street railway work. Their duties, while distinct and apart from ours, are just as essential, and the requirement is for the same degree of intelligence, industry and integrity. Their organization is young, and they are just starting out in their efforts to enlighten each other by a mutual interchange of information as to methods and ways. I allude to the Street Railway Accountants' Association. Let us not extend to them the right hand, but both hands, and help and encourage them to persevere in their good work.

Our meetings are always attended by quite a number of persons engaged in the same business as ourselves, but whose companies are not members of the association, and we receive requests for information from the same source, which information is always cheerfully given. We would not like to close our doors against these non-members, but we would be glad to enter their names in our official lists, and their annual dues, which is only a small amount, would fill an aching void in our treasury.

There is still another class, who although members of our association, seldom or never grace our meetings with their presence. Whether this may be from a lack of time, a feeling of exclusiveness or a consciousness of a possession of all the knowledge attainable concerning our business, I know not. But if the first, an effort and sacrifice might be made experimentally; if the second is the cause of their absence, a surprise and discovery is in store for them if they will only develop it. And if the last reason keeps them away a feeling of charity and good will for their fellow laborers should impel them to come amongst us and show us how to surmount our perplexing obstacle.

I wish that my successor in office may have a secretary and executive committee who so thoroughly realize and faithfully perform their duties as have the secretary and executive committee who have assisted me in the performance of my very pleasant work.

Mr. H. H. Littell offered a resolution heartily favoring the Street Railway Accountants' Association of America. The resolution was unanimously adopted.

Mr. P. F. Sullivan, general manager of the Lowell & Suburban Railway Company, Lowell, Mass., then read his paper by proxy, on "Municipal Ownership of Street Railways."[1]

Mr. G. W. Knox, Electrical Engineer, Chicago City Railway Company, then read his paper on "Some of the Difficulties Existing in the Construction and Operation of Electric Street Railways."

Mr. Knox did not charge up to stock manipulators and hard times all the crime of the necessity for receivership of many railways. With proper economies the latter could be made to pay dividends. The first consideration was a good corps of operators. Engines and generators have reached a high state of efficiency; the greatest opportunity for economy, therefore, lay in details of construction and operation. He cautioned against the assumption of self-satisfaction with one's own style of work. Then it was that manifestations of decay and inefficiency began. It was necessary to brush up against one's neighbor to learn what he was doing. To that end Mr. Knox advocated the organization of more State Railway Associations, where details could be discussed better than at the annual American Street Railway Association Convention. Cheap first cost of construction was also a fruitful source of subsequent expense, though companies have probably suffered from trusting contractors and supervising engineers too much. Mr. Knox also believed that every road should design

[1]See page 376.

its own supplies, as it knows best what it needs, and every order should be accompanied by a detailed specification. The author also did not believe in educating motormen to any extent in electrical knowledge, as they might be tempted to make repairs on the road, and thus block it, when troubles could be more quickly located and repairs could be better done in the repair shop. Many roads, according to Mr. Knox, were also wasting money by keeping too many records.

WEDNESDAY'S SESSION.

PRESIDENT McCULLOCH called the meeting to order at 10:30 a. m.

The Saginaw Street Railway Company, of Saginaw, Mich., acquired membership in the association and the report of the Auditing Committee was submitted.

MR. CHARLES HEWITT then read a paprer entitled, "Application of Storage Battery to Electric Traction."[1]

MR. HEWITT, in reply to questions, said that he had in mind the cities of New York and Washington, as cities where storage battery cars would be applicable. From his observation he believed that all small stations would be benefited in a large measure in their economy if they had a storage battery. As to the difference in cost between the k. w. output of the booster, independent of the battery, the only case in which he had had personal experience was the one in Philadelphia. He assumed the output of the booster to be the same as the general output of the station. No records had been kept of cost. The storage battery people had guaranteed the depreciation in his case and would in others.

MR. PATTERSON, of Salt Lake City, stated that his Company's plant, consisting of a water power, had been shut down on several occasions by accident, and inquired whether a storage battery would be of benefit to his plant, and where it should be placed. Mr. Hewitt replied that it would probably take a very large battery to take the whole load of Mr. Patterson's station, as the battery was usually intended to take care of the fluctuations in load only. The place for the battery would be at the distributing end of his transmission line.

MR. MacFADDEN, of Chester, Pa., inquired whether it would be economical to have a booster and storage battery combined, as a booster line, where one would only want the power at certain times, during heavy loads and on heavy grades. Mr. Hewitt thought that in the case of Chester a battery would not be of much benefit. Where, as at Chestnut Hill, in Philadelphia, the potential has to be boosted very high, a battery was desirable.

The local conditions of every case must be considered in all such installations.

MR. MUNDY, of Lowell, Mass., asked about the application of the battery, particularly in suburban work, such, for instance, as race track travel, without the use of the booster. If the battery were mounted in cars, would it be practicable to run these cars out in cases of special loads to the end of the route, when you will have the load, and then, during the race or other intermission charge the battery from the line. Mr. Hewitt replied that that was one of the variations of the scheme used abroad, which was perfectly possible. It is a matter on which an opinion could hardly be given off-hand.

MR. H. H. LITTELL, of Buffalo, stated that it had been shown to him that he could save $75,000 yearly in their operation by the use of the storage battery, and he was almost led to believe that they could do it, but they had not made any contracts yet. As regards the use of compound direct connected units in stations generting from 300 to 1,000 amperes, he cited the case of Easton, where before the use of storage batteries it required four engines to operate the road, whereas now only three were required. He estimated the economy to be 20 per cent.

MR. ELY, of Niagara Falls, agreed with Mr. Littell that this was probably the most important question coming before them as it meant, if successful, the saving of thousands of dollars. His company is taking power from the Buffalo & Niagara Falls Railway and the other street railways of Buffalo as well, from the Niagara Falls Power Company, and the Niagara Falls Hydraulic Power and Manufacturing Company. They generate the power and sell it to the street railway companies at so much per electrical h. p. per annum. The street railway company has to pay for the power whether it is used or not, and for eight hours of the day ,on an average, but a small quantity of the power will be used and for a certain number of hours, on their line particularly, for four or five hours, no power whatever is being used. If the accumulator could be used to store the current, and they could use it at times when they might not take it from the power companies direct, it would be a saving to his companies of thousands of dollars per annum. In Mr. Littell's case it would be a great saving. His Company was taking 1,000 h. p. daily, per annum, from the transmission line, and they were going to take more. Mr. Ely inquired of Mr. Hewitt whether, in his judgment, the state of the art had advanced to that degree that storage batteries or accumulators might not be safely, practically and economically installed to meet such cases. Mr. Hewitt replied that the batteries could undoubtedly be installed in such cases with economy. It was merely a question of size. A hearty vote of thanks and commendation was tendered to Mr. Hewitt.

The paper on "Power Distribution and Use of Multiphase Current Transmission for Ordinary Street Railways,"[2] by Mr. Maurice Hoopes, electrical engineer, Lynn & Boston Railroad Company, Lynn, Mass., was then read by the secretary, Mr. Hoopes being prevented from being present by illness. A vote of thanks was tendered to Mr. Hoopes.

MR. HEWITT stated that as far as the problems had come up in ordinary street railway work, with such distances as ordinary roads handle, he had been unable to figure any economy in the multiphase transmission, as compared with the direct using the booster. When one got to distances beyond, possibly fifteen miles, the problem then became more favorable to the alternating current. There were several things to be considered. In the first place, if one had a long line already running one has copper which one is already using on that line. The first thing to consider is whether this copper can be used in alternating transmission; and, in the second place, can the cables be used economically in an alternating current transmission. Very frequently they cannot. In Philadelphia they figured very carefully the question of alternating tri-phase transmission, in place of the battery, and found the battery more economical; and the results had shown conclusively that such was the case. It was a question in Mr. Hewitt's mind whether we are not on the eve of a very successful tri-phase motor, and instead of using the rotary transformers we will use the static transformers with a tri-phase motor on the car. He felt sanguine of the future possibility of this motor and had seen such motors work experimentally, and they bid fair to give very good results.

The President then appointed a Nominating Committee to nominate officers and select the place for the next meeting and the meeting then adjourned until Thursday morning.

THURSDAY'S SESSION.

PRESIDENT McCULLOCH called the meeting to order at 11 a. m.

MR. BACON, in the absence of Mr. Ford, chairman, read the report of the Committee on Standard Electrical Rules for Construction and Installation of Electric Wires. The report earnestly recommended the adoption of the National Electrical Code. The report was adopted.

MR. DIMMOCK, of the Omaha & Council Bluffs Railway & Bridge Company, addressed the meeting on the subject of United States mails, as to the amounts to be received from the Government for carrying the same, with the object in view of obtaining better rates, and a uniform price for the same.

MR. CHARLES N. DUFFY, First Vice-President of the Accountants' Association, made a brief address, in which he stated it was their desire, if possible, to promote a simple, wise and elastic system of accounting, which will be economical and uniform, so that, as far as possible, all street railway accounts shall be on the same basis, so that comparisons between different roads can be made.

MR. W. F. KELLY, chairman of the Committee on Standard Code of Rules for the Government of Street Railway Employés, reported that the adoption of such a code was desirable, and recommended that a committee be appointed to formulate such a code and submit it at the next meeting of the association.

The matter of proper compensation for carrying the United States mails was then taken up and discussed by several members.

The afternoon session was occupied with the reading and discussion of the following papers: "Discipline of Employés," by Geo. H. Davis. "The Application of Electricity to Railroads now Operated by Steam Power," by Colonel H. N. Heft. "Best Method of Settling Damage Cases and Prevention of Accidents by use of Fenders or Otherwise,"[1] by W. J. Hield. There was very little discussion.

Mr. Davis, in his paper, stated that a road has good discipline when all employés respect and kindly regard each other; when the officers do their best for the men, and vice versa; and when both officers and men sacrifice everything in the interests of the Company. The railway manager must gain the implicit confidence of his officers and men. Complete organization is the first requisite for discipline. All orders should be issued in printed form, clearly stated. Employés in all ranks

[1]See page 374.

[2]See page 373.

must be worked to their full natural capacity and physical strength. Nothing good or bad in a man's service should be passed without the manager's recognition; praise is a strong incentive to good work. An unusually large day's work should be followed by extra compensation.

The author suggested as a partial solution of the different questions arising in connection with discipline, a competitive civil service system, and gave in considerable detail the system employed by the Canal & Claiborne Railroad Company, which keeps a continuous record of the work of all employês. All vacancies are filled by promotion from among the employês when this is possible, and examinations are held for that purpose, which are taken in connection with the records of the men. The results obtained are excellent. A great advantage of the system is that it debars all considerations of outside influence or "pull," and all political interference.

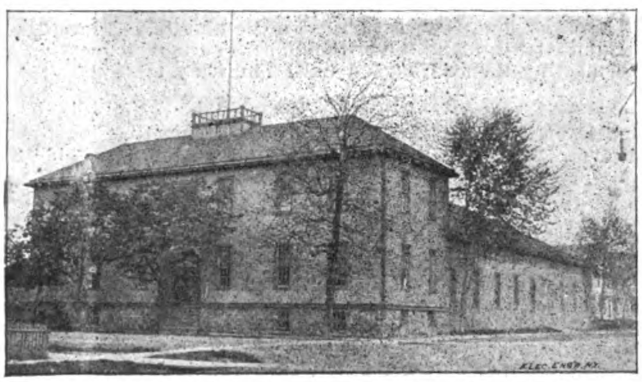
Closing routine business followed, with the election of officers for the ensuing year. The following were elected:

President, Albion E. Lang, Toledo, Ohio; first vice-president, W. Caryl Ely, Niagara Falls; second vice-president, J. A. Riggs, Reading, Pa.; third vice-president, E. G. Connette, Nashville, Tenn.; secretary and treasurer, T. C. Pennington, Chicago. Executive Committee: Robert McCulloch, St. Louis; C. D. Wyman, New Orleans; H. C. Moore, Trenton, N. J., John Roach, Chicago; R. S. Goff, Fall River, Mass.

Boston was selected as the next meeting place of the association.

In the evening the members sat down to a banquet at the International Hotel.

After the meeting adjourned many of the members walked across the upper Suspension Bridge on the Canadian side, where the cars of the Niagara Falls Park & River Railroad conveyed them to Chippewa and Queenston; from there they crossed to Lewiston and thence by the Great Gorge Route to Niagara Falls.



Convention and Exhibition Hall.

EXHIBIT OF THE WALKER CO.

A NOTABLE exhibit at the convention was that of the Walker Company, of Cleveland, Ohio, which, with its fine examples of electrical railway machinery, kept scores of interested spectators before it. All the items of the exhibit were handsomely finished and designed and made a most attractive spectacle even to the uninitiated. The feature of the exhibit was certainly the 400 h. p. elevated railway truck, which furnished an unsurpassed example of concentration of great power in small space. It consisted of a McGuire truck fitted with two No. 25 Walker elevated railway motors of 200 h. p. each. It was especially designed for the extremely heavy work to be met with in elevated railway traction and is capable of accelerating a three-car train to a speed of 25 miles per hour in 18 seconds. The motor is open to allow ample ventilation, while the bearings are self-oiling and so arranged that all waste oil is thrown back into the oil wells.

A double 4 A equipment, consisting of two 30 h. p. Walker motors, was shown on a Peckham truck and with the electric brake controller formed an example of the Walker Company's standard equipment for street railway work. The controller (type J 2) has been designed to meet the demand for quickly applied braking without the disadvantage of clogging the truck of the car with special gearing. While it accomplishes this thoroughly, the controller is very simple. To apply the brake the reverse handle is turned to the appropriate notch. This opens the trolley circuit and converts the motors into generators, the current developed being absorbed in a rheostat, and the pull of the fields on the armature produces the necessary braking. The contacts are arranged so that it can be used either as a gradually applied brake for ordinary stops or as one instantaneously applied in case of emergency. In addition to these two trucks a third was shown, designed for interurban service. This truck, a Dorner & Dutton, was fitted with two 50 h. p. motors and comprised, with the controllers shown, the Walker 10-S double equipment. The motors in both this and the preceding equipment are spring-suspended after the well known Walker method.

Controllers for all the standard equipments were shown from the single motor controller to that for the double 50 h. p. equipment.

An excellent idea of the Walker motor construction was obtained from the handsome single motors and parts, noticeable among them being an example of a 2-N 20 h. p. motor, designed for narrow-gauge work. One hundred and twenty of these motors have been sold in a single order to the Upper Silesia steam street railway, in Prussia, a steam road "electrified," where the track gauge is only 31 inches.

The 150 k. w. Walker street railway generator afforded a good example of modern generator construction. It is of 500 volts winding and has eight poles. Its protected back, ventilated armature and neatly wound field coils, protected with rope, were a few of its points of excellence. The brushes are held at a fixed angle with the commutator, yet the arrangement admits of the removal or replacing of a brush while the machine is in operation without risk to attendant or without loosening any screws or clamps.

The 25 k. w. generator on the right of the booth showed the smallest dynamo manufactured by the Walker Company. It weighs 4,200 pounds, and is capable of a continued output of 240 amperes at 125 volts; its speed is 300 revolutions per minute.

At the back of the booth was shown a large switchboard built for the Tamaqua & Lansford Railway. This is arranged for two 225 k. w. railway generators and has four feeder circuits. The board consists of four white marble panels mounted on an iron frame. Upon one panel are mounted the generator circuit breakers, ammeters, switches, lightning arresters and rheostats. On another are the main ammeter, a recording wattmeter and a recording voltmeter, all showing the total output of the station. On the other two are the circuit breakers, ammeters, switches and lightning arresters for the various circuits. Particular attention has been given to making all the connections on the back of the board in the simplest manner possible, and all contacts and connections are designed to carry double the normal load without appreciable heating.

A solenoid blow-out controller showed the latest type of street railway controller, as the embodiment of all the Walker patents.

To cut out a motor in case one becomes disabled it is not necessary to open the controller and pry out a plug which may be stuck from disuse. There are six positions appropriately marked for the reverse lever, instead of merely the usual "forward" and "reverse." There are five running positions of the controller. These are arranged for uniform graduations of speed and the rheostat is so proportioned that the car can be run any length of time on any notch.

The reverse cylinder is locked by a magnetic locking device, which makes it impossible to move the reverse when current is flowing through the controller. The solenoid blow-outs are coils embodied in the thin partition between the controller fingers. This protects them from injury by the arc. A marked advantage of this arrangement is that the absence of conducting core renders it impossible for a ground to develop in the solenoid circuit. The arc is blown out sidewise.

The space was brilliantly lighted by the now well known Walker enclosed arcs hung overhead. The Company was ably represented by Prof. S. H. Short and Messrs. Harding, Ferguson, Issertel, Black, Anthony, Dodd, Caldwell and Byrns.

EXHIBITION OF THE WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

IN accordance with the usual custom of the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., that Company again was prominent at the convention, both as to the size and strength of its representation and as to the excellence and tastefulness of its exhibit. At the last convention of the National Electric Light Association the Westinghouse Company established a new record in the exhibition line by a most tasteful and complete display of its varied manufactures, but what was more impressive to the guests the display was all set up and in shape when the convention opened. The preparation for that exhibit had been in charge of Mr. W. K. Dunlap, and owing to the favorable showing he made then he was again put in charge for the street railway convention, with the result that if anything he improved on his former effort and the exhibit was in consequence much admired and visited. The location was in the southeast corner of Armory Hall, immediately adjoining the entrance to

the meeting room of the delegates, and thus all of them had an excellent opportunity of seeing it. The space occupied was one of the largest and among the noteworthy apparatus on exhibition was the "Booster Outfit," consisting of a compound motor driving a 300 kilowatt series wound generator, with switchboard of marble, and all necessary switchboard appliances. In addition there were three double equipments of No. 12a, No. 38 and No. 49 motors, then three motors of the same type opened up and resting upon pedestals so as to afford an inside view. Latest types of switches, lightning arresters and all other appliances were shown, making a complete display of electric railway details. Literature descriptive of the Westinghouse Electric Railway apparatus was on hand in large quantities and photographs illustrative of the machines filled the walls surrounding the exhibit. Mr. Dunlap was ably assisted in his arrangement of the exhibit by Mr. M. McLaren, while the other Westinghouse representatives made up a large part of the floating population of Niagara Falls during the convention, circulating among the delegates and guests for the purpose of talking "Westinghouse." Among them were noticed R. S. Brown, C. A. Bragg, Maurice Coster, J. R. Gorden, N. W. Stover, J. P. Mallet, F. K. Siegfried and F. H. Heinrichs.

THE GENERAL ELECTRIC COMPANY AT THE STREET RAILWAY CONVENTION.

THE General Electric Company made a representative exhibit at the Street Railway Convention. The space selected by it was immediately to the left of the entrance on Walnut street, and the exhibit occupied 1,100 square feet. The moving part consisted of motors mounted on trucks. On a pair of McGuire double trucks, an axle of one carried a G. E. 53-forty-five h. p. motor, while on the other axle a 22-inch electric brake was mounted. On the other truck one axle carried a G. E. 51-eighty h. p. motor, while on the other axle was a 26-inch electric brake. This type of brake is designed for trailer car use or for application to the unoccupied axle of a car with a single equipment only, the stationary part of the brake being held in position by an iron bar attached to the truck frame. On a set of Brill double trucks were mounted four G. E. 57-fifty h. p. motors with electric brakes. This equipment is similar to that used on the Cleveland & Lorain Road, described in our last issue, where a high speed service of fifty miles an hour is carried on. To secure the necessary space on the axle for motor and brake the wheels on these trucks are dished. A Peckham cantilever truck carried a standard G. E. 52-twenty-seven h. p. motor and all were equipped with series parallel controllers.

The controller used on the McGuire truck equipment was of the new B 7 type, that on the Brill truck of the B 8 type. The G. E. 51 and G. E. 53 equipment were handled from one controller, either as a double equipment operating both motors, or, by cutting out either motor, as a single equipment. The wheels between the motor and the axle carrying the electric brake were geared together by means of bevel gears beneath the platform on which the truck rested. A. G. E. 55-one hundred and seventy-five h. p. motor was also shown, but not in operation.

In the Barney and Smith Car Company's exhibit two G. E. 1,000 motors were shown on a pair of that Company's class H trucks, while in the Peckham Truck and Wheel Company's exhibit two of the G. E. 52-twenty-seven h. p. motors were shown by that Company on one of its trucks. The General Electric Company had also equipped a car for the Duplex Company, of Boston, constructed by the Jackson Sharp Company, of Wilmington, on Peckham cantilever truck, with two G. E. 1,000 motors, electric brakes and the new B 13 controller. This was in active service on the tracks of the Buffalo and Niagara Falls Railway.

The apparatus showing the operation of the magnetic blowout comprised four types of automatic circuit breakers, K, L, M and Q, arranged to break currents up to 200 amperes. The H. D. lightning arrester, also fitted with the magnetic blowout device, was shown discharging under high potential current obtained from a Thomson X-ray inductorium to represent lightning, the discharge being followed by current from the 500-volt circuit. This enabled delegates to appreciate the method by which lightning discharges are safely handled in these arresters. The same panel carried another lightning arrester and a voltmeter. The voltage of the current used was increased to 2,000 volts, at which potential the lightning arrester discharged. This was exhibited to show that in cases in which wires carrying high potential current should fall across trolley wires with one grounded, the current would not pass through the motors, but will take the path through the lightning arresters.

Ten of the new G. E. railway arc lamps illuminated the space; in front was an ornamental cornice carrying colored incandescent lamps. Above and behind it was a large sign with the company's name, and on the wall another giving succinctly the railway record of the General Electric Company, viz., 2,173 generators aggregating 512,213 H. P., 46,191 motors aggregating 1,059,000 H. P., and 4,000 series parellel controllers. There was also a wattmeter exhibit, showing the street car meter and station output meter especially. The headquarters of the General Electric Company were at the International Hotel, where it had erected a small booth in which an X-ray exhibition was given continuously. The new screen first used on this occasion is fixed, twelve inches square, and platino cynide of barium is used instead of the ordinary fluorescing salt.

Its interests were cared for by the following representatives: H. P. Schuyler, Asst. Treasurer, Railway Department, —W. J. Clark, W. B. Potter, R. H. Beach, L. D. Tandy. Sche-

GENERAL ELECTRIC COMPANY'S EXHIBIT AT THE STREET RAILWAY CONVENTION.

nectady Office—J. G. Barry, Lee H. Parker, F. E. Case, W. G. Carey, E. D. Priest, F. M. Boyles, H. Kernochan. Supply Department—J. R. Lovejoy, H. C. Wirt, J. H. Aitken. Meter Department—C. D. Haskins. Convention Committee—F. M. Kimball, T. Beran, A. D. Page, manager incandescent lamp department, Harrison, N. J.

The sales office was represented as follows: W. G. Bushnell, A. B. Shepard, T. P. Bailey, E. D. Mullen, W. J. Crowley, C. C. Peirce, W. F. Hays, F. H. Strieły, S. W. Trawick and F. F. Barbour, Geo. D. Rosenthal, T. H. Fearey, D. F. Potter and Irving Hale.

The press affairs of the Company were, as usual, in the efficient hands of Mr. John McGhie.

THE STANDARD AIR BRAKE COMPANY.

THE Standard Air Brake Company had a striking exhibit which greatly eclipsed those of former years. Not only was it an object lesson, but it showed the great progress which that energetic Company had made. As is generally known, the Standard Air Brake Company was the first concern in the world to build street railway air brakes, and its exhibit practically illustrated the different types of apparatus manufactured, from the beginning of its business to date.

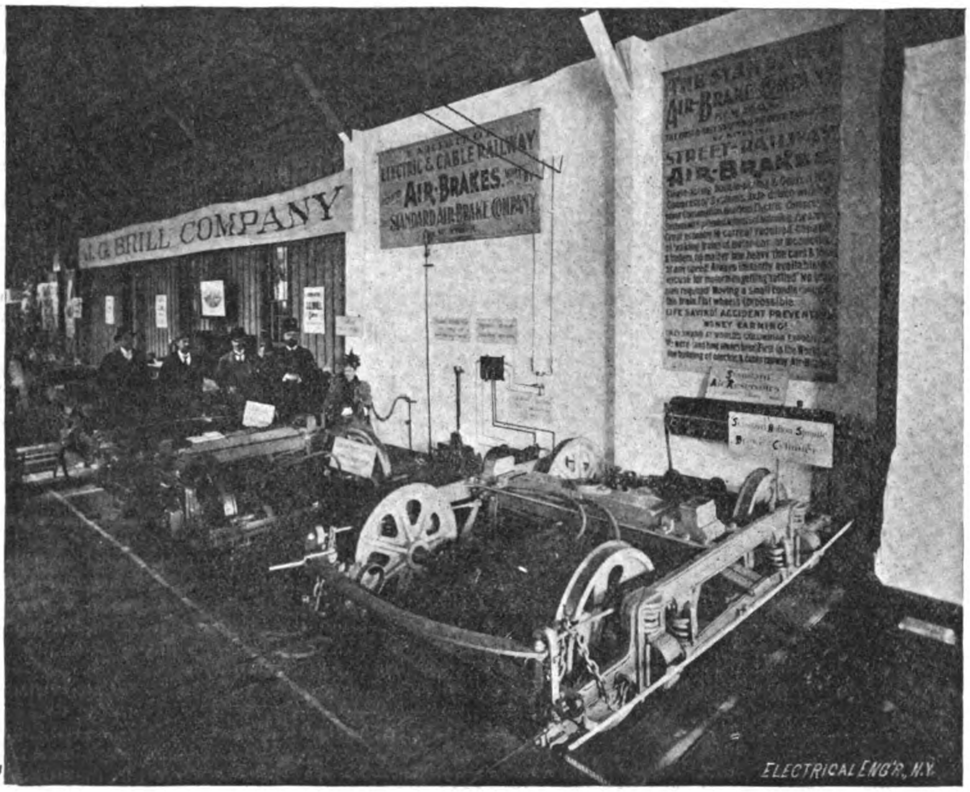
Their exhibit occupied a prominent space adjoining the Brill Company's, and was inspected with interest by the delegates. The apparatus was in charge of the Company's managing director, E. J. Wessels, who was assisted by the chief engineer, E. H. Dawson, Jr. The Company was also represented by Messrs. George E. Pratt and C. B. Fairchild, special agents, H. B. Taylor ,assistant engineer, and E. E. Robinson, foreman.

On entering the exhibit on either side was to be found a Brill No. 27 truck, the one on the left equipped with the well known duplex compressor, direct axle driven. There are many of this type in service here and abroad. Thirty are completing their third year of active service on the Buffalo Railway Company's road. On the right was shown the well known geared compressor, which is the standard on several roads in the United States and Canada. This type has proved admirably suited for heavy traction and high speeds. Back of the duplex was shown the Standard Company's hollow spindle brake cylinder, with fulcrum on back head for equalizing double truck brake rigging. A handy attachment enabled delegates to see how quickly and easily pressure can be applied. The attachment embraced a graduated spring, with a pressure indicator which showed the range from minimum to maximum, the latter being equal to an emergency stop. There was also shown the well known Standard interlocking handle, by means of which the controlling valve was worked; also the "Chime Whistle." This was blown from time to time and announced to delegates that the Standard Company was, as usual, actively in the field.

Adjoining this stood the automatic current controller, which excited favorable comment from the numerous delegates who watched the precision and accuracy of its movements, and were surprised at the narrow limits within which it operated. This device makes it unnecessary for the motorman to have any connection with cutting current in or out.

Next to the current controller was shown the Company's water and dust proof electric compressor. Its freedom from vibration and noise was very remarkable. The ease with which it compressed air quickly and the remarkably small space it occupied excited much interest. The motor compressor was piped to a 14x48-inch special reservoir. The Company's reservoirs are guaranteed to resist a far higher pressure than is required when operating the Standard system.

Next was shown a No. 1 type brake cylinder, with attachments illustrating the manner in which trail cars are braked. In addition there was a profusion of special hose, couplers, gauges, regulators, and mufflers, the whole giving a comprehensive idea of the entire Standard air brake system, and showing its remarkable simplicity as well as the substantial character of the apparatus.



WORKING EXHIBIT OF THE STANDARD AIR BRAKE CO.

The Company's display was augmented by views of cars and trains in different parts of the globe on which Standard air brakes are used. The Company's World's Columbian Exposition diploma and medal were also displayed, and a striking sign proclaimed that the "Standard" was first in the field and the only concern which had received a diploma and medal.

The Standard Air Brake Company's Australian agents, Messrs. Noyes Brothers, were represented by Mr. Edward Noyes, the senior partner, of Sydney, New South Wales, who was an interested spectator and gave those who inquired a graphic report of the satisfaction which Standard air brakes had given in the distant colony in which he resides. Great credit is due to Mr. Wessels for his untiring energy, which has not only kept his Company at the head of the street railway air brake industry, but has led to the building up of a large and constantly increasing business.

MR. WILLIAM F. ELLIS occupied a small space, showing the product of the Continuous Rail Joint Company, of Newark, N. J., and Dilworth, Porter & Co., of Pittsburg.

THE STEEL MOTOR CO.

A very fine and interesting exhibit was made by the Steel Motor Company, of Johnstown, Pa., of their specialties in the line of steel railway motors, controllers and other appliances. They have lately been bringing out some new apparatus of very high grade, and this was not only placed on view, but put into frequent operation. Their new No. 20 is a 25 h. p. motor, and their new No. 34 is a 50 h. p. motor, both built of low carbon cast steel in two sections, of cylindrical form, wholly enclosed, and with four poles. The poles are of laminated wrought iron, with serrated face, each with its own coil, and the drum armatures are remarkable pieces of construction, the winding consisting of only 33 coils, inserted compactly into that number of slots. The two types are differentiated for their special work. Two of the 50 h. p. type were shown mounted on a Dupont truck, equipped with a Clark liquid brake, and the armature was also shown separately, as well as the two latest and very efficient forms of controllers. In charge of the exhibit were J. N. Thomas, vice-president and general manager; R. T. Lane, secretary and treasurer; J. A. Rutherford, general sales agent, and O. D. Henry.

Just adjoining was the fine steel rail exhibit of the Johnson Company, showing special work, heavy girder types, etc., with Major Evans close at hand.

The Clark brake shown on the Steel Motor Company's equipment is made by the Company and is the invention of Mr. Clark, so long prominently connected with the Westinghouse air brake interests. The brake was shown on another truck also, but the working exhibit was that in the Steel Motor space, where Mr. Clark himself gave explanations and exhibitions of its great power and celerity. The liquid used is water and glycerine. It is worked by hand lever, the small pump attached thereto being double action, and bolted to the car platform, one and a half strokes of the lever applying the brake in ordinary cases at 50 pounds pressure. The handle of the release valve is within easy reach of the motorman's thumb, on the lever stem. The brake cylinder is fitted with three pistons, and the smallest cylinder is of sufficient area to move the brake gear, take up the slack of shoes and journal boxes and set the shoes with great force. When the controller valve is at the right point of pressure it opens and the liquid enters the large cylinder, applying the brake with maximum force. The quantity of liquid used is about 20 cubic inches. Two cylinders are used, one on each side of the car. The foundation brake gears are independent of each other. Much interest was shown in the frequent operation of the whole truck equipment and the use of the brake.

MUNSELL AND MICANITE EXHIBITS.

One of the most attractive and interesting exhibits at the convention was that of the Mica Insulator Company, of New York, Chicago, London. Prominently located at the left of the main entrance, their handsomely decorated booth in yellow and green presented a very attractive appearance. Commutator rings, segments, troughs, tubes, discs, plates and various forms of insulation were largely displayed, and were of special interest to all electric railway men. The Company's new product, known as M. I. C. Compound, was for the first time exhibited. Some ten different grades and styles of Micanite and Empire cloths and papers were shown. This is probably one of the largest exclusive exhibitions of insulating material ever made, and goes to show the progress which the Company has made during the past four years in bringing to perfection this particular and highly important branch of the electrical industry. Mr. Charles E. Coleman, of the Chicago house, was in attendance, and had charge of the exhibit. Mr. Franklin Brooks, vice-president of the Company, was also in attendance one or two days.

Eugene Munsell & Co., New York and Chicago, also made a very fine display of their "India and Amber Mica," both in the sheet as it comes from the mines, and as segments for railway motors. The exhibit was made in connection with that of the Mica Insulator Company. Several sets of various sized segments were attractively displayed beneath a large signboard on which were shown a full line of VanWaggoner & Williams Hardware Company's drop forged copper segments, for whom the Company are general Western selling agents. At the entrance to the booth was shown "India Mica," cut in sizes from 9-16x4⅛ to 8x10 inches. This large range of sizes indicated that the firm are prepared to furnish "Mica" in almost any size, shape or pattern. A souvenir in the form of a "Mica Mine" puzzle was given out and was sought for as much as any one souvenir at the convention. Parties not in attendance can secure these souvenirs by writing the Company at either New York or Chicago. While seemingly difficult to get all the miners into one mine, the feat is easily accomplished when you know how. The exhibit was in charge of Mr. Charles E. Coleman, of the Chicago house.

THE MORRIS AND DOLPH COMBINATION EXHIBITS.

A shrewd and successful combination exhibit was that made by Elmer P. Morris and J. C. Dolph, as principals, in behalf of a large number of concerns and specialties represented by them. They had two large connecting rooms on the ground floor of the Cataract House, opening to the street piazza, and on the outer wall hung their sundry banners. A remarkably comprehensive display was made, supplemented by a private wine cellar and a very unretiring brass band. Mr. Morris was responsible for the displays of the Keystone Instrument Company, of Philadelphia, Mr. Stevens also being present; the Electric Railway Engineering Company, of Cincinnati, street railway supplies; Simonds Manufacturing Company, gears and pinions; Forsyth Bro. & Co., car fixtures, etc.; Hope Electrical Appliance Company, switches and cut-outs; Hemingray glass specialties; Wheeler Reflector Company, headlights, etc.; W. E. Harrington's duplex car signs; McGuire trucks, etc.; Point Marion Manufacturing Company, poles, brackets, pins, etc.; Garton-Daniels lightning arresters; Bradford Company's belting; Monarch insulating paint.

The J. C. Dolph Company had about as many things to its share of the show, and among them may be named the Forest City protected bonds and roll drop and drop forged commutator bars; Sterling insulating varnishes; Catskill Foundry gears and pinions; the American Mica Company's goods; D. & W. Fuses, and carbon brushes, headlights, trolley details, lamps, etc. It was a complete exposition in itself, supplementing the other.

EXHIBIT NOTES.

MR. FRANK H. CLARKE, so long known in and around Washington in connection with Thomson-Houston and General Electric interests, greeted many old friends at the convention, and gave them the news of his going to Chicago to represent in the West the growing business of the Electric Storage Battery Co. of America.

THE E. T. BURROWES CO., of Portland, Me., had a large exhibit of car shades, curtains and fixtures in great variety. Mr. W. S. Calhoun and Mr. H. H. Russell represented the company. They made quite a hit with their souvenir, which was a condensed Webster Dictionary small enough to go in a vest pocket.

MR. C. E. GREENE, Niagara Falls, N. Y., had a neat little exhibit of high insulation line material in the shape of glass and porcelain insulators, pins, brackets, arms, etc. The exhibit was made on behalf ow Mr. Fred Locke, whose fame has gone so wide afield.

AMERICAN ELECTRICAL WORKS, of Providence, R. I., did not make an exhibit, but distributed a very handsome souvenir in the shape of a letter weight, made of a section of their copper line furnished for the Niagara-Buffalo power transmission. It was in great demand for its intrinsic and historical value. The company were represented by Messrs. P. C. Ackerman, F. B. Baker and F. E. Donohoe.

HARRINGTON RAIL BONDING CO., which has lately been doing a great deal of work in the vicinity of New York, was represented by Mr. S. H. Harrington, president.

CREAGHEAD ENGINEERING COMPANY, of Cincinnati, Ohio, made, as usual, a very interesting, attractive and complete exhibit, which included their well known flexible brackets, both plain and ornamental. These brackets are standard on high speed roads, and are manufactured in the best possible manner. They also exhibited a full line of their overhead line material, malleable iron pole fittings, strain insulators, section insulators, etc. The display was in charge of their well known and popular superintendent, Mr. G. R. Scrugham, and was tastefully arranged. Their souvenir was a neat steel pocket rule, in a leather case, and was much sought after, being handy and useful.

HERRICK & BURKE had a neat working exhibit, under Mr. A. B. Herrick, of their electrical car inspection system, the board being surrounded all the time by busy inquirers. This strikes one as a very simple system, whereby every possible fault that can arise in an equipment may be quickly and accurately determined. All the ills that cars are heir to show up—a poor motorman, a bad rheostat, injured fields, short circuited armatures; and thus efficiency can be maintained easily, an equivalent being furnished to the visual inspection of a steam locomotive.

ELECTRIC STORAGE BATTERY COMPANY, OF AMERICA, had a remarkably neat and effective exhibit of their street railway system for maintaining constant regulation on a road, the cells being charged from the local street railway circuit, and grouped on each side of a small board on which the instruments were mounted. In this grouping the battery was connected to line through a resistance representing the feeder. A variable resistance across the battery represented the varying load on the line. An ammeter in the feeder cir-

cuit showed the load and variation. An ammeter in the battery circuit showed the charge and discharge. An ammeter in the variable load circuit showed the variation of line load. A voltmeter across the battery terminals showed also the variation of line pressure at that point. With an average load of 60 amperes on the feeder circuit the outside circuit was varied from 0 to 200 amperes; the feeder stayed steady and the battery changed from 60 amperes to a discharge of 140, to keep the load constant; the voltage varying from 108 to 118 on this work. The exhibit was in constant operation to show the instantaneity of effect in keeping up the constant load and preventing fluctuation in the working circuits of a street railway. The exhibit and Company were represented by Messrs. Herbert Lloyd, Charles Blizard, Frank H. Clark, Justus B. Entz and J. Y. Bradbury.

GENERAL INCANDESCENT ARC LIGHT COMPANY had a very neat and comprehensive exhibit in one of the large rooms of the Cataract House under the charge of their general manager, Mr. E. Lavens. It comprised an excellent display of the Company's well known enclosed arcs, several of which were shown on a large frame. A series of four of them running off the street railway circuit gave a wonderful volume of pure and steady light. These are the Standard No. 2850, for regular 500-volt lamps. A full line of the ornamental lamps attracted much favorable comment. At one side of the room was a neat slate board, on which were mounted a set, in vertical and horizontal positions, of the Company's all drawn pure copper "quick break" blade switches, single and double throw. These are intended to care for a large amount of current at a high voltage, and have the great advantage that the current carrying blades are not affected by the arc in breaking, as the current is broken by a separate and independent blade at a part of the switch points different from that used for contact. The Paterson, N. J., Edison Company has such switches, carrying no less than 6,000 amperes. On the same board were shown the Bergmann radial voltmeter and ground detector switches and radial differential voltmeter switch.

MR. W. H. RUSSELL, president of the Russell Manufacturing Company, of Chicago, took pleasure in showing their curve-taking trolley harp and other devices which they manufacture.

MR. W. A. WASHBURNE, New York State agent for the Cambria Iron Co., had an attractive booth with a table well filled with sections of their girder and guard rails and steel "T" rails and fastenings.

THE CORNING BRAKE SHOE COMPANY, of Buffalo, showed a line of their combination hard and soft iron shoes. Mr. Francis Granger, their New York agent, showed up the goods.

THE CRANE COMPANY, Chicago, took pleasure in explaining the superiority of a large group of extra heavy valves and steam fittings, the largest valve being for 250 pounds steam pressure. Mr. R. T. Crane, Jr., was present.

MR. A. L. DANIELS, of the H. B. Camp Company, Aultman, Ohio, was located near the door leading to the main hall with samples of Camp's vitrified underground conduit, which has become so popular.

THE COLUMBIA MACHINE WORKS, of Brooklyn, N. Y., had a corner which was not unnoticed. Commutators, bearings and car trimmings was their special feature. Mr. J. G. Buehler and Mr. W. R. Kerschner were always to be seen.

MR. J. R. CRAVATH, of the Cravath Manufacturing Company, Chicago, had his novel device called the Cravath excessive current recorder, which he claims will stop the leak in electric railway operation. It attracted a great deal of well deserved attention.

ADAMS & WESTLAKE COMPANY, of Chicago, had a very attractive booth, showing the Acme curtains, headlights, brake handles, electroliers, signal lamps and interior car trimmings. Messrs. H. E. Keeler, W. S. Bartholomew and Louis A. Gray were in attendance.

THE KAUFFMAN CONKEL COMPANY, of Canton, Ohio, represented by Mr. W. J. Kauffman and Mr. L. A. Loichot, occupied a small space with a model of their automatic cut-off and emergency device rendering falling trolley wires harmless.

PRATT & LETCHWORTH COMPANY, of Buffalo, showed a large variety of malleable iron and steel castings. Mr. C. R. Brown and Mr. W. A. Angel were in charge of this interesting exhibit.

THE FUEL ECONOMIZER COMPANY, of Matteawan, N. Y., presented many of the visitors with a neat little souvenir in the shape of a card case. In their quarters was a model of the Green's fuel economizer, showing details of construction and arrangement; also specimen pipes and sample castings. Mr. P. J. Challen, their assistant general manager, had their exhibit in charge and was busily occupied in consultation with those who, in growing numbers, are coming to appreciate the value of this excellent apparatus.

MR. I. E. STOREY, of Philadelphia, was present in the interest of his well known motors, which are being applied to an endless variety of power purposes. Street railway men have very varied requirements and the fame of the Storey motors has long since reached them. Mr. Storey is understood to have done some snug business while at the Falls, and found a host of old friends.

JOSEPH DIXON CRUCIBLE COMPANY, of Jersey City, occupied space No. 39. Their mammoth "Uncle Sam" lead pencils were in great demand and one of the most attractive souvenirs of the convention. Their exhibition was in charge of John H. Baird and their Eastern agent, A. L. Haasis. These gentlemen did nothing but talk about their graphited wood gear grease and give lead pencils away. This grease, they said, modestly, is the only thing of the kind which will prevent noisy gears, being a mixture of cedar wood pulp and Ticonderga flake graphite oils and fats. The cedar wood pulp reduces the jar of the gear against the pinion and the graphite reduces the wear on both. There is no dripping of the grease from the gear cases, soiling the tracks, as it is a solid lubricant and will not ooze out of the case. Being much lighter in weight than ordinary grease, the gear is always covered, and such a thing as a gear coming into the barn "dry" is impossible where this "graphited" wood grease is used. Dixon's silica graphite paint for car trucks, also shown, will stand both the mud and sand abrasion, and will look well on a truck for a year. It was shown made in four colors, each being an attractive and durable shade. Special attention was called to their foliated flake graphite, graphite commutator spark arrester, in stick form, graphite pipe joint cement, which should be used in place of red lead, thus ensuring the easy release of the pipe when necessary to disconnect. The Dixon traction belt dressing, also exhibited, absolutely prevents the belt from slipping and thoroughly preserves the leather and protects the elasticity of the belt.

H. W. JOHNS COMPANY had an interesting exhibit, and Mr. Meek found full occupation for his time in explaining the merits of their electric car heaters. Nor was Vulcabeston forgotten.

L. A. CHASE COMPANY, of Boston, were represented by their well known Mr. Condit, who had plenty of data at hand about the Elden circuit breaker and other specialties.

THE CARBORUNDUM COMPANY at Niagara were ready as usual with their characteristic liberality to do the honors of the occasion, all the members and their friends being welcomed at their interesting works and allowed to study the processes, which is a great deal more than can be said of some of the other concerns using Niagara power. The novel name "Carborundum" is already a household word in the arts and daily becomes better known. In close attendance on the convention for the Company was Mr. T. J. Tone.

MR. A. C. VOSBURGH was present in the interests of the New Process Rawhide Company.

CHRISTENSEN ENGINEERING COMPANY, of Milwaukee, had a very extensive exhibit of their air brakes for street cars, all the details being shown in operation, including their motor compressors, switches, pumps, brake handles, etc. One of the equipments shown was that for the Sprague multi-unit system of car control. Among those present for the Company were N. A. Christensen, P. S. Drexel, C. F. Marshall, G. Myers and F. C. Randall.

BENEDICT & BURNHAM MANUFACTURING COMPANY were represented by E. H. Oswald.

MR. N. JACKSON presented, not infrequently nor with lack of eloquence, the claims of the Electrical Mutual Casualty Association, Scranton, Pa.

MILLER-KNOBLOCK COMPANY, with their admirable hydraulically compressed commutators were represented by Mr. A. W. Morrell. There was an exhibit in the Central Electric space.

THE STANDARD PAINT COMPANY were to the fore with Mr. J. C. Shainwald as their representative. He talked of many things, but most forcibly of P. & B. specialties.

FOREST CITY ELECTRIC COMPANY, of Cleveland, were represented by Mr. G. A. Thomson. There was an exhibit in the Morris-Dolph parlors of delight.

THE WEATHER was varied and chiefly abominable. It accounts for the delay in photographing pictures of the chief exhibits, etc. A few appear in this issue of The Electrical Engineer., and others will follow.

ATTENDANCE.—The buttons ran out early, so large was the attendance. The registers and a moderate allowance for those who did not or could not register showed some 750 manufacturers and supply men present, 350 to 400 street railway men, 150 ladies, and local friends and visitors several hundred strong. The exhibits at night were crowded to excess by the people of the Falls and Buffalo.

THE PECKHAM TRUCK CO. were represented by Edgar

Peckham, president; J. A. Hanna, W. H. Gray, A. W. Field, E. G. Long and Chas. Ackley and by Mr. Terry, their mechanical engineer, of Kingston. They showed a system of double trucks, consisting of seven different kinds, from the light maximum traction for city service to their heavy electric locomotive truck for trunk line service. It was a splendid display and included one No. 7 D single truck, which is one of an order of 100 trucks for the Cincinnati Street Railway Company; two side frame trucks of their standard form and extra long trucks. Also in the Walker Company, Westinghouse and General Electric's exhibits were shown their extra long single trucks. On the street were shown their rotary snow plows. One of their extra long trucks was on one of the "Duplex" cars running on the Gorge road. The Peckham Company are to be complimented on their effective, tasteful and convincing exhibit.

MR. EDMUND G. FISHER, manager for the McMullen Woven Wire Fence Company, of Chicago, gave out a very useful souvenir in the form of a leather card case. They occupied a booth fenced in with the different styles of their woven wire fence.

MR. J. M. ATKINSON, of Chicago, was present at the convention talking rail bonds as usual. Mr. Atkinson distributed freely a unique souvenir in the shape of a little coil thermometer made up in a button form for wearing on the lappel of your coat.

THE STERLING SUPPLY AND MANUFACTURING CO., New York, exhibited in room 234 of the International Hotel their Sterling safety brake, car registers, etc., which they manufacture. Probably the handsomest and most expensive souvenir given out at the convention was the combination clock and paper weight presented by this company. Messrs. L. E. Roberts, F. A. Morrell and William Tiffany were at their headquarters.

MR. HERMAN HIRSCH, of New York, exhibited a model truck, equipped with Buschners anti-friction bearing, which they claim saves 33⅓ per cent. in motive power.

THE TAYLOR ELECTRIC TRUCK CO., of Troy, N. Y., occupied extensive quarters showing one pair of their double trucks, equipped for either 2 or 4 motors on a car; one of their latest improved single trucks for inclosed cars; and one single truck with extension truss for long open cars. Messrs. John Taylor, A. T. Reynolds and A. Tupper were the company's representatives.

R. D. NUTTALL COMPANY, of Pittsburg, were very much in evidence with a full line of their street railway specialties, such as gears, pinions, trolleys, sleet wheels, etc. The company was represented by Messrs. F. A. Estey, Chas. N. Wood, Garson Meyer, A. S. Partridge, Scott R. Hayes, Chas. B. Arthur and George W. Provost.

EDISON-BROWN PLASTIC RAIL BOND COMPANY were represented by Messrs. Harold P. Brown and Franklin Sheble and had a neat and striking exhibit of their bonds. An interesting feature was the bond taken up at Camden, N. J., by Mr. W. E. Harrington after two years use ,when the bond, of the "cork type," was found to be in perfect condition, with the surfaces as clean and bright as when the bond was placed originally in the ground. The exhibit was also well equipped with literature on the subject.

MR. LUTHER STIERINGER took in the convention on his way back from the Omaha Exposition, and was cordially greeted by a host of old friends.

AHEARN & SOPER, the well known Westinghouse agents, of Ottawa, Canada, were represented by Mr. T. Ahearn, who, by the way, is just off on another trip around the world with his family.

AMERICAN DISTRICT STEAM COMPANY, whose Holly system is being adopted by many electric companies for the sale of heating steam, was represented by Mr. Norman G. Allen.

CAPTAIN W. L. CANDEE was present in the interests of Okonite, for which the railway demand is larger than ever, while in all other lines also he was able to report large sales.

MR. E. O. SESSIONS, superintendent of the electrical department of Frank Jones, the Portsmouth, N. H., brewer, took an active interest in all that was going on. It may not be generally known that Mr. Jones has a few millions invested snugly in several lighting and railway enterprises of his own.

DR. W. M. HABIRSHAW and Frank Harrington looked after the interests of the India Rubber and Gutta Percha Insulating Company, much of whose work is in evidence in and around Niagara for power transmission and other purposes.

MR. FREDERIC NICHOLLS, general manager of the Canadian General Electric Company, came across from Toronto to represent Dominion traction interests, with which he is largely identified as manufacturer and financier.

CONSOLIDATED CAR HEATING COMPANY, of Albany, N. Y., had a neat and tasteful exhibit under the care of Mr. J. F. McElroy, their consulting engineer, with whom were associated Messrs. H. N. Ransom and W. P. Cosper. By means of a large board bank of lamps the temperature regulating switch was shown cutting in and out sections of the heaters to suit conditions. The Company stated that they have equipped 5,000 cars on 250 roads.

THE CUTTER ELECTRIC AND MANUFACTURING COMPANY showed a full line of I. T. E. circuit breakers, single and double pole, for alternating current, one of which was 3,000 ampere double pole, probably the largest circuit breaker ever made. Their exhibit was in charge of Mr. H. B. Kirtland and Mr. W. M. Scott, electrical engineer of the Cutter Company, and attracted much attention.

WELLS & FRENCH COMPANY, of Fisher Building, Chicago, had an exhibit of their Curtis truck, equipped with two Westinghouse motors, and fitted with a Price momentum friction brake, which they manufacture, and which appears to have given very good results on the Chicago system. Mr. W. G. Price, the inventor, assisted in showing its operation. Mr. Frederick Saxelby, a veteran electrical engineer, now Eastern representative at 100 Broadway, N. Y., was in charge of the exhibit as a whole.

MR. E. P. SHARP, of the D. S. Morgan Building, Buffalo, had a neat exhibit of some of his second-hand specialties. His ability to make and offer tempting bargains was well tested there and throughout the convention.

THE WASHINGTON CARBON CO., of Pittsburg, were represented by Mr. J. S. Crider, who had much to tell the delegates regarding the excellent qualities of domestic carbon brushes for railway use. Mr. Crider also promises a new electric light carbon, which will be exceedingly acceptable to users of enclosed arc lamps.

D. & W. FUSE CO., Providence, R. I. Mr. L. W. Downes looked after the interests of this company and had a most interesting exhibit of their patent fuses, which break 500 volt railway currents of large amperage without any flash and almost noiselessly. The exhibit attracted wide attention, especially where short circuiting through fuses of other manufacturers, as the contrast is, to say the least, extremely striking.

GOLD STREET CAR HEATING COMPANY, of New York, had an excellent and welcome display of their standard and newer types of heater. The ingenious and compact form illustrated in the last issue of The Electrical Engineer was the centre of attention and admiration, and deservedly so. It was shown in all its parts, assembled, under a car seat, etc., and visitors were invited to handle it and study it critically. The Company was well represented by Mr. Edward E. Gold, president; W. E. Banks, treasurer; John E. Ward, of the New York headquarters, H. E. Beach and F. Weston. One of the most popular, and certainly the most conspicuous, souvenirs of the convention was the Gold walking stick, which was eagerly sought after, being quite handsome and of considerable intrinsic value.

MR. JOHN C. DOLPH, of New York, looked after the interests of the Forest City Electrical Works, of Cleveland, and had some nice samples of roll-drop commutator segments to show.

THE NATIONAL WATER TUBE BOILER CO., of New Brunswick, N. J., had a popular representative on the ground in Mr. C. Y. Flanders, who, while not exhibiting, had much of interest to tell about the National boiler.

THE HEINE BOILER CO., of St. Louis, Mo., had their affairs entrusted to the hands of Mr. H. B. Hess and Mr. Russell Walker, who both discoursed interestingly on the many virtues possessed by Heine boilers.

F. E. HOMER & CO., of Cleveland, had a neat little exhibit of commutators, of which they make a specialty. Mr. Homer was present and interested the delegates in the subject of quick renewals of worn out commutators on railway motors and generators.

THE HEMINGRAY GLASS CO., of Covington, Ky., showed a few of their numerous styles of glass insulators, and Mr. Dan Hemingray was present during the whole time of the convention to look after their interests. Mr. Hemingray states that they are at present extremely busy, and glass is still maintaining its popularity as a leading insulator for railway currents.

THE CARD ELECTRIC CO., of Mansfield, Ohio, had its affairs entrusted to Mr. W. H. Jacob, who, while not exhibiting, had much to relate of the vast progress made by his company in the past few years. The Card Company are getting large orders, and are at present as busy as they can be.

THE SOLAR CARBON CO. of Pittsburg, were well represented by Mr. F. M. Laughlin and H. E. Webb. They had no exhibit, but appeared to require none, so well and favorably are their goods known to street railway men.

THE PARTRIDGE CARBON CO., of Sandusky, Ohio, were well represented by Mr. James Partridge, whose long experience in the special manufacture of carbon brushes makes him an ever welcome visitor to conventions, and to street railway men who are troubled with difficulties in their commutators.

THE TRIUMPH ELECTRICAL CO., of Cincinnati, were well represented by Mr. C. S. Reno, who had many friends among the delegates and who had a convincing way of talking of the merits of Triumph apparatus and Cincinnati in general.

JEWELL BELTING CO., of Hartford, Conn., were represented by Mr. C. L. Tolles and A. E. Silk, whose friends at the convention were legion. Belting is an ever interesting topic, and Messrs. Tolles and Silk found many willing listeners. There are still a few pocket books left which they will be glad to send to their friends.

THE CHICAGO INSULATED WIRE CO., of Chicago, were represented by Mr. W. M. Smith, whose popularity gave him a hearty reception from his numerous friends among the delegates.

THE SIEMENS-HALSKE ELECTRIC CO., of Chicago, were ably represented by Mr. H. C. Spaulding, of Boston, whose extensive acquaintance gave him a ready audience at all times with street railway men.

THE JOHN STEPHENSON CAR CO., of New York, had D. W. Pugh and Mr. John A. Tackaberry on the ground. They had no exhibit, their name being so well known that it appeared superfluous. They distributed the familiar Stephenson note books.

VAN WAGONER & WILLIAMS MANUFACTURING CO., of Cleveland, Ohio, were represented by Mr. C. S. Van Wagoner. This company are large manufacturers of commutators and commutator segments, and the excellent quality of their manufactures has almost instantaneously given them an extreme popularity among purchasers of this class of goods.

THE PETTINGELL-ANDREWS CO., of Boston, were well represented at the convention by their ever popular salesman, Mr. J. E. Wilson, whose acquaintance among the street railway and supply men bespoke him a ready hearing, when expounding the merits of many specialties which he had to show, of interest to them.

CENTRAL UNION BRASS CO., of St. Louis, manufacturers of commutators and segments, were represented by Mr. T. C. White, who made himself exceedingly popular by the distribution of a neat little souvenir model of a commutator, for which the demand was simply enormous.

WENDELL & McDUFFIE, of New York, were both present and maintained their deserved popularity among the street railway men. Mr. Wendell was specially in demand in the evening, as his excellent story-telling and recitations made him a most welcome guest.

BIBBER-WHITE CO., of Boston, were represented as usual by the indefatigable Mr. C. E. Bibber, whose acquaintance among electrical men extends from Maine to California, and from the St. Lawrence to the Gulf. This company are going more extensively into the railway field and are building some important roads in New England, besides conducting a general supply business.

MR. C. T. BURNS was present in the interests of his firm, the Buffalo electrical house of C. T. Burns & Co.

SAFETY INSULATED WIRE CO. were represented by Mr. Harry Richards. They made no exhibit, but every morning when the delegate got up he found under his door a letter containing a testimonial from some street railway company as to the merits of their cables in the largest systems extant. An impression was thus neatly made. With Mr. Richards was Mr. M. B. Austin.

ROCHESTER CAR WHEEL WORKS were represented by Mr. F. D. Russell, as usual, whose souvenir was a neat purse, emblazoned with the picture of their well known wheel.

MR. NORMAN McCARTY, St. Charles Hotel, Toledo, Ohio, an "old timer" in the lighting and railway field, was once again in evidence. He is looking around for something good and solid to push, and will be glad to enter into negotiations with those wishful of availing of his long experience.

CENTRAL ELECTRIC CO., of Chicago, had a large exhibit which was at once substantial and showy, its light and color catching the eye, and its many standard specialties or ingenious novelties arresting the step of every passerby. The name of the company was very conspicuously displayed above the exhibit, and right in front hung the Helios 150 hour street railway enclosed arcs. The cut glass globe gave a wonderfully pretty effect. Other prominent features were the Billings & Spencer drop forged bars, the Garton lightning arresters, the Bound Brook bushings, the Hill switches, steel trolley poles and a big line of overhead railway material. The company were well represented by W. R. Garton, the manager of the railway department, and H. E. Adams, the Eastern representative.

JOHN T. McROY had a neat exhibit of his vitrified clay conduits, such as have already come into large use in electrical work.

"TALLY-HO."—The social side was not neglected by the General Electric Company. On Tuesday it arranged an enjoyable tally-ho and carriage party over to Canada. This courtesy was taken advantage of by nearly every lady at the convention. Parlor D was the company's social annex, which, after about 9 a. m., was the centre of attraction with its galaxy of talent, display of medals and the X-ray exhibit.

GARL ELECTRIC CO., of Akron, O., had a neat exhibit of its telephonic apparatus, consisting of the full run of material, but chiefly the street car telephone system. The desirability of such telephone connection between cars and headquarters is well known and the matter has been very carefully worked out by the company, their portable apparatus being handy and efficient. The company, which is also in the construction and supply business, was represented by Mr. Garl.

J. G. BRILL CO. not only had several of their fine trucks scattered around in the various electric motor and brake exhibits, but had a large space devoted to their specialties, and showed also complete equipments on the tracks outside the hall. Messrs. John A. and Edward Brill and a whole army of assistants were in attendance.

ELECTRICAL AND MECHANICAL ENGINEERS were out in conspicuous numbers. Note is made elsewhere in other items of those attached to the electrical companies, and among the others may be mentioned Messrs. L. B. Stillwell, E. P. Roberts, A. Boissonas, C. J. Field, W. Grauten, E. P. Harris, H. G. Issertel, John J. Moore, H. A. Foster, A. Mann, W. E. Partridge, E. J. Richard, W. N. Smith, J. J. Swann, G. H. Walbridge, H. H. Harrison, J. G. White, L. Winters, J. Farrell, W. G. Ferguson, W. E. Harrington, A. L. Johnston.

JOHN A. ROEBLING'S SONS CO. were very well represented indeed, Mr. H. L. Shippy himself being there, as well as Messrs. G. C. Bailey, M. R. Cockey and J. F. Doyle. The wires, cables, bonds, etc., of the company are in universal use and esteem and no small proportion of the street railway men present were walking testimonials as to their merits.

THE "KERITE" wires and cables of W. R. Brixey were represented by Mr. Geo. F. Porter.

MR. C. R. HUNTLEY and a host of other Buffalo electrical celebrities, not by any means the least among whom was Mr. George Urban, graced the proceedings and took an active part in all the social exercises.

ROSSITER, McGOVERN & CO. were well in evidence not only where discussion was rife and sales were to be made, but in the mazes of the dance and the social functions of the convention. It was a wrench for Mr. Frank McGovern to tear himself away on Thursday from the scene of his terpsichorean triumphs, where he had become famous as one of the best dealers and dancers ever seen at an A. S. R. A. meeting.

MR. W. E. HARRINGTON showed a new and cheap "Duplex" illuminated car sign, one of the best things of its kind we have ever seen, free from extra wiring, equally legible by night and day, interchangeable, and doing its duty as a sign with 100 per cent. efficiency. It will be popular.

MR. J. J. GHEGAN, of J. H. Bunnell & Co., of Cortlandt street, New York, was busy on the scene as representative of that pioneer and progressive house, which was collectively and individually, as to its partners, one of the first to show a strong faith in electric traction. No new thing of merit comes along that they do not push or supply the apparatus that is needed for it.

LESCHEN-MACOMBER-WHYTE CO., of Chicago, wire and cable folk of excellent standing, made a distinct hit with their pamphlet containing "The Clink of the Ice," by Eugene Field. It struck many a responsive chord in many a manly bosom.

MR. ALLAN V. GARRATT was present in the interests of the Lombard water wheel governor, which has fairly won its place in the water power art as a "real good thing" not to be dispensed with. He had some excellent practical literature on the subject, and could instance the plant of the Niagara Hydraulic Company as proof of all assertions. With him was Mr. Daggett, in behalf of the Lombard Hydraulic Brake Company, whose apparatus for street cars he lost no opportunity to advocate strenuously.

HOLMES, BOOTH & HAYDENS were represented by Mr. J. O. Crane, their general agent.

MR. A. O. GARRISON, of the management of the Columbia Incandescent Lamp Company, St. Louis, was very active throughout the convention, as the lamp has already won a great many friends in the street railway field and is steadily gaining more, on its merits.

MR. J. HOLT GATES, of Chicago, represented the Walker Company and himself as to other specialties.

POST-GLOVER ELECTRICAL CO. were adequately represented by their Mr. Samuel W. Glover.

MR. F. W. DARLINGTON, E. E., of Philadelphia, had some tasteful literature in regard to his electric railway and electric fountain work.

WESTERN ELECTRIC CO., who are large makers of street railway material, were represented by their Mr. S. A. Chase.

STANDARD UNDERGROUND CABLE CO. had space and rooms engaged, but at the last moment the pressure of actual

work in hand was so great, no one could be spared. "Too busy to come" isn't such a bad annonation.

BUCKEYE ELECTRIC CO., of Cleveland, were represented by Mr. Bailey Whipple, who brought a variety of the Buckeye incandescent lamps with him.

MR. THOMAS F. MORRIN, president of the Clonbrock Steam Boiler Co., of Brooklyn, N. Y., exhibited a small model of the Morrin Climax boiler. He gave out a very appropriate souvenir.

STANDARD THERMOMETER AND ELECTRIC CO., of Peabody, Mass., were represented by Mr. M. L. Livingston, their assistant manager, and Mr. Albert Mann, their Buffalo agent. They displayed a variety of their open and enclosed arc lamps, which burned beautifully and attracted much attention.

OHIO BRASS CO.—None who entered the hall could fail to see the grand display made by the Ohio Brass Co., whose booth was directly opposite the entrance. Their exhibit consisted of overhead material for street railways, appliances for round wire and special devices for "Figure 8" wire, different hangers, strain insulators and special bell made bearings, track brushes and adjustable track holders, feed wire splices, commutators, headlights and many other devices, which there is not space to mention. Messrs. C. K. King and A. L. Wilkinson were in constant attendance.

MR. BAILEY WHIPPLE represented the Jandus Electric Company, of Cleveland, and made a display of several Jandus enclosed arc lamps, as well as distributed literature in regard to them.

CHACE CONSTRUCTION CO., of Detroit, were represented by their Mr. G. E. Fuker.

HUNTER ILLUMINATED SIGN CO., of Cincinnati, were represented by Lytle J. Hunter.

NEWS AND NOTES

TUBULAR ELECTRIC FURNACE.

Demetrio Helbig has constructed an electric furnace which, while unable to provide the fierce heat of the Moissan furnace, has the advantage of furnishing a constant high temperature which may be maintained uniform over a larger area. The tubular furnace consists of a sheet-iron box closed at the ends by means of square diaphrams of compressed magnesia or other refractory substance. The diaphrams are perforated to permit the insertion of a carbon tube 50cm. long and 2cm. in diameter, with walls 5mm. thick. The ends are held by iron collars, to which the terminals of an electric circuit are clamped. On sending a current of 250 amperes at 40 volts through the carbon cylinder it is heated to an intense white heat, and bodies inserted in the cylinder may be kept at a high and uniform temperature by regulating the current. A piece of Bayeux porcelain becomes as viscous as hot glass in six minutes. At first there is a slight difficulty, owing to the oxidation of the white-hot carbon by the oxygen of the air; but this is rapidly used up, and then the tube is surrounded by an atmosphere of nitrogen and carbonic acid. It might be advisable to keep the whole apparatus surrounded by an inert gas from the beginning.

PHOTO-VOLTAIC CURRENT AND CATHODIC ABSORPTION OF LIGHT.

Profs. Elster and Geitel, in "Wiedemann's Annalen," deal with the relation between the photo-voltaic current and the kathodic absorption of light when the angle of incidence and direction of polarization of the incident light are varied. The experiments, which were conducted with the assistance of the Elizabeth Thompson Science Fund, of Boston, show that the current, so far as it depends on these factors, is determined by the amount of light absorbed at the kathode, and the agreement between the curves representing the current and the absorption affords a striking confirmation of the theory of metallic reflection.

MAPPING ALTERNATE CURRENT WAVES.

At the recent meeting of the British Association at Toronto several forms of apparatus for mapping out the form of an alternate current wave were described and exhibited. In the instrument of Prof. Rosa a contact revolving on the dynamo shaft puts a point in the circuit into contact with a potentiometer at any phase of the revolution. By means of an electromagnetic ratchet arrangement the contact can be advanced in phase by small equal amounts, and the same current similarly rotates a revolving cylinder on which the length of wire necessary for a balance on the potentiometer is automatically recorded. Mr. Duddell makes use of the force urging a straight conductor carrying a current and stretched in a magnetic field; two-parallel phosphor-bronze strips are placed in a strong magnetic field and attached to a mirror, so that when the alternating current goes up one of these strips and down the other one the mirror is deflected. Prof. Braun uses a kathode ray instead of a strip, and puts in it a magnetic field set up by the alternating current; the ray is thus deflected and follows every pulsation of the current.

PHOTO-VOLTAIC CURRENTS IN PHOTOGRAPHY.

A photo-voltaic theory of photographic process forms the subject of a lengthy investigation by H. Luggin (Zeitschrift fur physikalische Chemie, xxiii. 4). It was shown by Becquerel, in 1839, that the haloids of silver are capable, under certain conditions of giving rise to photo-voltaic currents; and Herr Luggin finds a close connection between these currents and the decompositions which give rise to photographs. A remarkable feature is the reversal of the voltaic current which occurs when a certain potential has been reached, a consequence of which is that the same electrode is capable, according to circumstances, of giving rise to currents of opposite signs, and these Herr Luggin distinguishes as "normal" and "solarization currents." The former are the most susceptible to blue, and the latter to yellow light. The whole investigation tends to throw light on the much-debated theories of photographic action by showing that both the latent picture of photographic negatives and the visible transformations of the printing-out process have their counterpart in definite photo-voltaic phenomena.

A PECULIAR CASE OF DEATH BY LIGHTNING.

The deaths from lightning in this country are, happily, very few, being only about 1 per million of the population per annum. Sometimes no sign of injury can be seen upon the victim, but in other cases marks are left upon the body, or clothes are scorched, and more than one case has been recorded where boots have been torn off the feet and nails driven out of the soles of the boots. Seldom, however, does it happen that lightning leaves such remarkable evidence of its transit as that disclosed at an inquest recently held at Hulford House, near Guildford, and reported in the Lancet. The evidence showed that on Wednesday, August 25, there had been a single flash of lightning and a clap of thunder, and about half an hour afterward Major Jameson was found lying on his face in a field, quite dead. Around him, in a radius of several yards, were his clothes and boots, which had been torn and scattered about in an extraordinary manner. The lightning appears to have struck him on the right side of the head, tearing his cap to pieces and burning his hair off. It then passed inside his collar down the front of his body and both legs into his boots, which were torn to pieces, and then passed into the ground, making a hole about eighteen inches in circumference and three inches deep. His collar was torn to pieces, the front of his shirt was rent into ribbons, the jacket and undervest were literally torn to shreds, and the knickerbockers he was wearing were stripped from him and scattered on the ground. His stockings and gaiters were similarly torn in pieces, and on the boots the lightning had a remarkable effect. They were burst open, some of the brass eyelet holes were torn out, nails were forced out and the soles were torn off. The skin had been torn off the chest, and the right leg was torn and blackened; blood was issuing from the mouth and right ear. It is difficult to account for these appalling effects or to explain why the electric discharge should produce widely different results upon different occasions.—Nature.

MEASURING SPECIFIC HEAT BY ELECTRIC CURRENT.

At the recent British Association meeting Prof. Callendar and Mr. Barnes gave an account of their new method of measuring the specific heat of liquid by passing an electric current through a fine tube through which a current of the liquid flows. The experiment is continued until the temperature-difference between the ends of the tube becomes steady; this temperature difference and the rate of flow of the liquid are then measured. Loss of heat by radiation is almost eliminated by surrounding the tube with a vacuous chamber, and small losses are allowed for. Another important communication on calorimetry was that of Profs. Ewing and Dunkerley on the specific heat of superheated steam. Their method consists in passing saturated steam through a porous plug, thus superheating it; the results show that for 10 degrees superheating at atmospheric pressure the specific heat is about 0.44, while the ordinarily accepted value, 0.48, is only correct if the superheating exceeds 25 degrees, as in Regnault's experiments.

HARRIS' LITHIA SPRINGS, S. C.—Mr. Harris, proprietor of the resort, is proposing to utilize water power in the vicinity for five miles of trolley line and electric lighting.

PERSONAL

A FAREWELL DINNER TO LORD KELVIN.

UP to the last moment of his departure with Lady Kelvin for England, on the "Campania," on October 16, Lord Kelvin was extremely busy, either as a sightseer or as the recipient of official and private hospitality. His last week was spent in New York, and one of the last places he inspected was the new Columbia University on Morningside Heights.

Friday evening, October 15, a farewell dinner in his honor was given by Dr. Robert Abbe, and his brother, Prof. Cleveland Abbe, an old friend of Lord Kelvin, as a final expression of the personal admiration and good will entertained toward the great physicist and electrician in America. Those present around Dr. Abbe's hospitable board in West 50th street were: Lord Kelvin, Dr. Robert Abbe, Profs. C. F. Chandler, J. H. Van Amringe, R. S. Woodward, Cleveland Abbe, N. M. Butler, Drs. J. S. Billings, J. W. McLane, A. L. Fisk, General Alex. S. Webb, Messrs. William E. Dodge, Everett P. Wheeler, T. C. Martin, Hubert Howson, Joseph Larocque, John Bottomley, Benj. S. Church, H. R. Marshall, S. D. Babcock, Richard Watson Gilder and President E. B. Thomas, of the Erie Railroad. With many of the guests Lord Kelvin is on terms of personal intimacy extending through long and eventful years, and the dinner partook of the nature of a delightful reunion of old acquaintances. No attempt was made at formal speeches, but the interchange of ideas and opinions between Lord Kelvin and his American friends was very full and free, and the evening will be long remembered by all who thus assembled to say good-by to the vigorous Nestor of English science. Lord Kelvin left in the best of health and spirits and in exchanging good-byes said he had gathered so much information and had seen so many things to think about he hoped that if spared to come back it might not be twelve years again, because things become wholly new in America in a much less period than that.

THE J. G. WHITE DINNER.

Seizing the opportunity when so many of his friends were at Niagara attending the Street Railway Convention Mr. J. G. White, well known as an electrical engineer and builder of railway and lighting plants, invited a number of them to dinner on Tuesday evening, October 20, at the Buffalo Club. The party were taken over on a beautiful special car of the Buffalo & Niagara Falls Railway Company, whose system was constructed by Mr. White and whose lines parallel at many points the famous Niagara-Buffalo pole line, also built by that gentleman. The dinner, served in the best style of a club renowned for its hospitality, was accompanied by music, etc. Among those present were President McCulloch, of the association; State Railway Commissioner Ashley Cole and Mr. C. R. De Freest, the secretary of the commission; J. G. White, C. R. Huntley, George Urban, Jr., J. B. Marston, L. B. Stillwell, W. M. Habirshaw, T. C. Martin, W. J. Clark, W. F. Zimmermann, J. H. McGraw, E. E. Higgins, G. Tracy Rogers, N. H. Parker, C. W. Price, F. S. Kenfield, C. S. Sergeant, Charles T. Ballard, W. Caryl Ely, F. W. Brooks, W. A. Brackenridge, T. C. Pennington, Captain J. Brinker, G. H. Dunbar, H. H. Harrison, D. B. Dyer, B. F. Thurston, H. J. Pierce, H. St.C. Denny and H. W. Littell. Several speeches were made, bearing testimony to the many sterling qualities of the host of the evening, and a number of hours were spent most agreeably around the table. The special car landed the Niagara guests at their hotel at 2 a. m., after a whizzing trip at the rate of thirty or forty miles an hour.

REPORTS OF COMPANIES

WESTERN UNION ANNUAL REPORT.

The report of the Western Union Telegraph Company shows for the fiscal year ended June 30 gross revenues of $22,638,859, and net revenues of $5,732,203. Of this $4,792,855 was paid out in dividends, $895,509 in interest, and $39,991 to the sinking fund. The balance, $3,847, was added to surplus, making the total on that account on June 30 the sum of $7,647,541.

During the year £2,100 sterling bonds, due March 1, 1900, were redeemed by the sinking fund trustees, and $87,000 of 5 per cent. collateral trust bonds, due January 1, 1938, were issued in exchange for stock of the New York Mutual, International Ocean, and Gold and Stock Telegraph Companies, upon which, under the leases, interest was being paid at the rate of 6 per cent. per annum.

This refunding operation on a small scale makes especially pertinent the item in the report showing that of the Company's own bonds $781,002 in sixes fall due March 1, 1900; that $4,920,000 sevens are due May 1, 1900, and $1,163,000 sevens are due May 1, 1902.

The report adds that "the proceeds of the sale of 20,000 shares of the capital stock of the Company were applied to construction account, the expenditures on that account for the fiscal years 1893, 1894, 1895 and 1896, as shown by the annual reports, having exceeded the amount of the surplus by about $2,000,000. During the year we have added to our system 696 miles of poles, 14,073 miles of wire and 44 offices. The number of messages transmitted shows a decrease of 608,760 from the number transmitted last year. This decrease was in a great measure due to the continued depression of general business throughout the country during the fiscal year to which the figures refer, although part of it is to be attributed to the business transmitted over leased wires, the returns from which are not accounted for on a message basis.

"The condition of the Company's property is being continually improved by the use of the best material and most modern appliances in all construction and reconstruction.

"The Company has shared in the revival of business since the close of the fiscal year. Our test office weekly statements continue to show a substantial increase in our receipts. If the same percentage of increase is kept up throughout the current year, as the present commercial conditions indicate that it is reasonable to expect that it will be, the next annual statement will show a larger balance after the payment of interest and dividend charges."

The general figures of earnings were:

	1897.	1896.		
Net revenue	$22,638,859	$22,612,736	Inc.	$ 26,123
Expenses	16,906,656	16,714,756	Inc.	191,900
Balance	$5,732,203	$5,897,980	Dec.	$165,777
Int. and sink. fds...	935,501	933,958	Inc.	1,543
Balance	$4,796,702	$4,964,022	Dec.	$167,320
Dividends	4,792,855	4,767,805	Inc.	25,050
Surplus	$3,847	$196,217	Dec.	$182,370
Previous surplus ...	7,643,694	7,447,477	Inc.	196,217
Total surplus	$7,647,541	$7,643,694	Inc.	$3,847

At the annual meeting of directors last week the former board was elected, with one exception, Jacob H. Schiff taking the place of John Van Horne.

Mr. Van Horne's retirement from the directorate and vice-presidency closed a service of forty-seven years with the Company, and was necessitated by personal reasons, much against the wishes of his colleagues. In his place as vice-president Mr. T. F. Clark was elected. That gentleman has been serving for some time as assistant to the president.

TO MANUFACTURE CARBIDE UNDER THE BOHM PATENT.

The Electro-Chemical Manufacturing Company has been organized under the laws of New Jersey, with a capital stock of $1,000,000. The incorporators are G. W. Vaillant, Dr. L. K. Böhm and Charles N. King.

The Company will manufacture calcium carbide under the patent of Dr. Böhm. This patent was originally filed November 5, 1891, and issued December 24, 1895. It is entitled, "Material for Incandescent Conductors," No. 552,036, and under it Dr. Böhm claims to have the basic patent for manufacturing calcium carbide by the action of the electric current. Following are some of the claims:

2. The hereinbefore described process of forming electrical conductors consisting of mixing together carbon and the oxides of the earth alkali metals to form a homogeneous composition and thereafter effecting a chemical combination of the carbon and metal by the action of an electric current, substantially as described.

3. As a new article of manufacture, a compound or substance for electrical conductors consisting of a homogeneous mass of carbon and calcium forming the carbide of calcium.

The specification of the patent describes the use of calcium carbide as a filament for incandescent lamps.

MRS. H. A. MOTT, formerly superintendent of the Newark Telephone Co. has become general superintendent of the Paterson, Passaic and Suburban Telephone Co.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCTOBER 5, 1897.

Alarms and Signals:—

AUTOMATIC FIRE ALARM. T. F. Robinson and F. Smith, Little Falls, N. Y., 591,009. Filed Feb. 1, 1897.
Comprises a plunger normally held out of contact by a pin adapted to break or fuse at a predetermined temperature.

HEAT DETECTOR. H. Ruetschi, Newark, N. J., 591,143. Filed March 25, 1897.
Thermostat operating to close circuit and sound alarm when temperature reaches a predetermined degree.

ANNUNCIATOR. F. P. Stevens, Colorado Springs, Colo., 591,179. Filed October 13, 1896.
Details of construction.

Batteries, Secondary:—

HIGH TENSION BATTERY. R. Ashley, Port Republic, N. J., 591,265. Filed November 27, 1895.
Composed of a number of trays of insulating material, arranged in a vertical stack or pile, but out of contact with each other.

Conductors, Conduits and Insulators:—

FLEXIBLE METALLIC TUBE OR CONDUIT. H. H. Brooks, Medford, Mass., 591,092. Filed August 21, 1897.
Comprises a lining composed of a strip of sheet metal provided with an insulating coating and formed into a spiral.

INSULATOR FOR ELECTRIC WIRES. W. Roberts, Mobile, Ala., 591,104. Filed November 3, 1896.
Is provided with a transverse opening, a slot to admit the wire into the opening and a groove intersecting the slot and adapted to retain the wire.

JUNCTION BOX. J. Cloos, Milwaukee, Wis., 591,226. Filed March 6, 1897.
Means whereby any feeder may readily be dissociated from its mains and whereby the mains may individually be dissociated from each other.

OUTLET BOX FOR ELECTRIC WIRES. W. Soons, New York, 591,300. Filed December 24, 1896.
Provides pillars for the support of a rosette or other insulation fixture some distance from the bottom of the box.

Dynamos and Motors:—

DYNAMO ELECTRIC MACHINE. M. E. Thompson, Ridgeway, Pa. 591,024. Filed April 12, 1897.
Embodies a coil of wire having a binding-wrapper, as of cord, and studs projecting from the faces of the coil, and having feet engaging under the wrapper.

COMMUTATOR FOR DYNAMO ELECTRIC MACHINES. J. J. Wood, Ft. Wayne, Ind., 591,203. Filed April 29, 1897.
Details of construction.

ALTERNATING CURRENT ELECTRIC MOTOR. O. B. Shallenberger, Rochester, N. Y., 591,242. Filed June 7, 1888.
Comprises a coil, a closed circuit conductor at an angle, but in inductive relation to it, and an armature placed within the inductive field of both the coil and conductor.

ALTERNATING CURRENT GENERATOR. C. S. Bradley, Avon, N. Y., 591,267. Filed June 22, 1896.
Is provided with means for varying the rate of alternation, and adjusting devices to vary the product of capacity and inductance to produce resonance at the several rates.

ALTERNATING CURRENT MOTOR. C. S. Bradley, Avon, N. Y. 591,268. Filed June 22, 1896.
An induction motor having a revolving element inductively related to a rotary magnetic field and inductively related to an auxiliary stationary circuit including current regulating devices.

ALTERNATING CURRENT ELECTRIC MOTOR. W. Stanley, Jr., Great Barrington, Mass., 591,301. Filed October 23, 1888.
Embodies in an alternating current electric motor, having consequent field-magnet poles, independent armature and field-magnet coils, and a second set of field-magnet coils connected in circuit with the armature coils.

MAGNETO ELECTRIC GENERATOR. J. A. Williams, Cleveland, Ohio, 591,365. Filed May 3, 1897.
Comprises a pole piece consisting of a plate, cut, stamped and formed with the lower edge slitted, folded upward, and with the outward bends forming seats for the permanent magnets.

Electro-Metallurgy:—

PROCESS OF AND APPARATUS FOR ELECTROLYTIC EXTRACTION OF METALS FORM THEIR SOLUTION. J. W. Richards, Bethlehem, Pa., 591,141. Filed March 6, 1897.
Consists in subjecting such solutions to the electrolytic action of an electric current passing into the solution by a liquid amalgam anode, and separating the anode from its cathode by a porous partition.

PROCESS OF OBTAINING CAST TITANIUM. H. Moissan, Paris, France, 591,355. Filed May 3, 1895.
Consists in subjecting an oxid of titanium in presence of carbon to an electric arc produced by a current of from 1,000 to 2,000 amperes, and 60 to 70 volts, thereby fusing the titanium, which combines with the carbon.

Electro-Therapeutics:—

ELECTRICAL APPARATUS FOR SURGICAL PURPOSES. W. E. Dow, Braintree, Mass., 591,160. Filed August 16, 1897.
A rheostat comprising a resistance coil, a contact piece in constant electrical engagement with its convolutions, and means acting upon rotation of the coil, to cause axial movement of the latter.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. C. S. Van Nuis, New Brunswick, N. J. 591,026. Filed May 1, 1896.
An inclosing globe for the arc, a cap provided with two or more chambers having apertures through which a carbon passes and valves for each chamber permitting the escape of gases to the exterior.

ELECTRIC ARC LAMP. E. P. Warner & A. J. Oehring, Chicago, Ill., 591,182. Filed August 10, 1896.
Feed mechanism for ribbon feed arc lamps.

Measurement:—

METHOD OF AND APPARATUS FOR MULTIPLE RATE METERING FOR ELECTRIC CURRENTS. E. Oxley, Washington, D. C., 591,194. Filed August 23, 1897.
One meter at each point of consumption, also a definite resistance, a means controlled from a single point for inserting and withdrawing the resistance from the meters and armature circuits.

METHOD OF AND APPARATUS FOR MULTIPLE RATE METERING FOR ELECTRIC CURRENTS. E. Oxley, Washington, D. C. 591,195. Filed Aug. 23, 1897.
Similar to above.

ELECTRICAL MEASURING INSTRUMENT. O. B. Shallenberger, Rochester, Mass., 591,241. Filed Jan. 26, 1897.
Comprises a permanent magnet having polar extensions and magnetic shield partially surrounding the extensions for equalizing the distribution of the magnetic field.

SPEED AND DIRECTION INDICATOR. B. A. Fiske, United States Navy, 591,162. Filed Feb. 24, 1896.
Apparatus for indicating at a distance the direction and speed of rotation of an engine shaft of a steamship.

ELECTRIC GAS LIGHTING APPARATUS. A. L. Bogart, Jamaica, N. Y., 591,071. Filed Feb. 24, 1897.
Adapted for Welsbach burners.

Miscellaneous:—

ELECTRIC BELL CHIMING APPARATUS. N. McMenamin, Trenton, N. J., 591,002. Filed Nov. 18, 1896.
Employs a keyboard with one key for each bell, and the bell clappers are connected with levers, operated by an electromagnetic arrangement.

ILLUMINATED ELECTRIC SIGN. G. K. Burleigh, Northfield, N. H., 591,369. Filed Oct. 31, 1896.
Means for automatically changing the colors thrown upon the transparent display ground.

METHOD OF MAGNETIZING. W. D. Marks, Philadelphia, Pa., 591,081. Filed Aug. 3, 1897.
Consists in first heating the steel to a sufficient degree, then simultaneously subjecting it to the influence of a magnet and immersing it in a tempering bath.

ELECTRO-MAGNETIC BRAIDING MACHINE. A. C. Shuttleworth, Philadelphia, Pa., 591,105. Filed March 2, 1896.
Details of construction.

CASH REGISTER. C. McNabb, Knoxville, Tenn., 591,176. Filed March 5, 1897.
Employs electric circuits operating indicators interposed therein and a circuit breaker common to and controlled by the operating keys of the machine, whereby the circuits may be automatically established and broken at each operation of the register.

ELECTRIC CLOCK. C. Gullberg, Jersey City, N. J., 591,217. Filed Feb. 25, 1897.
Details of construction.

Railways and Appliances:—

AUTOMATIC TEST CIRCUIT. L. G. Rowand, Camden, N. J., 591,010. Filed Dec. 22, 1896.
Details of construction relating to railway circuits.

ELECTRIC RAILWAY. J. C. Henry, Denver, Col., 591,100. Filed June 29, 1897.
Comprises a plurality of electric supply circuits, a series of motors having their fields excited from one of the circuits by a circuit independent of the armature circuits, and variable connections between the supply circuits and the armatures of the motors.

TROLLEY FINDER FOR ELECTRICAL RAILROADS. P. Goldsmith, Troy, N. Y., 591,251. Filed February 10, 1897.
Employs two flaring arms adapted to engage the wire when the trolley wheel leaves it.

ELECTRIC RAILWAY SYSTEM. G. Westinghouse, Jr., Pittsburg, Pa., 591,314. Filed February 19, 1894.
Sectional working conductors arranged in laterally disposed pairs, and means for automatically connecting a stationary source of current with every alternate pair of sections in multiple during the passage of the car.

TROLLEY FOR ELECTRICAL CARS. W. L. Harvie, Newton, Mass., 591,042. Filed Oct. 2, 1896.
Details of construction.

PNEUMATIC AND ELECTRIC CONTROLLED BRAKE. H. S. Park, Chicago, Ill., 591,262. Filed July 2, 1888.
Employs electrically controlling devices, whereby the exhaust port may be alternately controlled by the fluid pressure-operated valve device or by the electrical controlling device.

Regulation:—

PHASE ADJUSTING METHOD AND MEANS FOR ALTERNATING CURRENT APPARATUS. O. B. Shallenberger, Rochester, N. Y., 591.240. Filed Jan. 9, 1897.
Applicable to instruments for indicating the energy of alternating currents.

INDIRECT REGULATION OF DYNAMO ELECTRIC MACHINERY. G. S. Dunn, East Orange, N. J., 591,343. Filed July 8, 1896.
Combines a main machine and a regulating machine, the latter having two opposing field coils, one the excitation of which is constant, and the other connected in series with the armature of the regulating machine, its armature being connected in series with a field coil of the main machines.

INDIRECT REGULATION OF DYNAMO ELECTRIC MACHINERY. G. S. Dunn, East Orange, N. J., 591,344. Filed July 10, 1896.
Similar to above.

INDIRECT REGULATION OF DYNAMO ELECTRIC MACHINERY. G. S. Dunn, East Orange, N. J., 591,345. Filed June 22, 1897.
Similar to above.

Switches, Cut-Outs, Etc.:—

PLUG SWITCH. W. R. Cole, Detroit, Mich., 591,126. Filed March 11, 1897.
Details of construction.

ELECTRIC SWITCH. W. A. Drewett, Brooklyn, N. Y., 591,331. Filed March 15, 1897.

A switch for rheostats embodying a spring controlled contact arm.

LIGHTNING ARRESTER AND CUTOUT. C. Branzell, Ashland, Wis., 591,321. Filed April 1, 1897.
Particularly adapted for use in connection with telegraph instruments.

Telegraphs:—

RAILWAY TELEGRAPH. A. C. Frieseke, Floral Bluff, Fla., 591,339. Filed November 20, 1895.
Means whereby only one train will be in communication with the dispatcher's office at a time.

Telephones:—

TELEPHONE SYSTEM. A. W. Rose, New York, 591,011. Filed October 7, 1896.
Details of construction.

TELEPHONE EXCHANGE SYSTEM. W. R. Cole, Detroit, Mich., 591,127. Filed April 28, 1897.
Of the "group system" variety. Details of construction.

MULTIPLE SWITCHBOARD FOR TELEPHONE EXCHANGES. W. S. Nash, Knoxville, Tenn., 591,192. Filed May 20, 1897.
Details of construction.

ELECTRICAL EXCHANGE. A. B. Strowger, F. A. Lundquist and J. and C. J. Erickson, Chicago, Ill., 591,201. Filed July 17, 1895.
Automatic telephone exchange details.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCTOBER 12, 1897.

Alarms and Signals:—

FIRE ALARM. S. W. Ludlow, Cincinnati, Ohio, 591,408. Filed Nov. 20, 1896.
Consists of a suitable base, provided with several chambers containing fulminate and with a fuse connecting all these chambers, and in one of these chambers a friction pin for igniting the fulminate operated by the expansion of the contents of an outer chamber filled with a volatile substance and exposed to the outer temperature.

THERMIC FIRE ALARM. K. O. Slosky, Philadelphia, Pa., 591,700. Filed June 5, 1897.
Consists of two concave-convexo discs, having their surfaces corrugated, contact points carried by the disks, and an electric circuit, in which the alarm is included.

PROTECTING ALARM CIRCUIT. I. E. Barriclow, Dallas, Tex., 591,725. Filed June 22, 1896.
Employs an alarm device held normally inoperative by two balanced powers, either of which actuates in the event of the other losing power.

Batteries, Primary:—

GALVANIC BATTERY. C. B. Schoenmehl, Waterbury, Conn., 591,427. Filed Feb. 2, 1897.
Details of construction.

Conductors, Conduits and Insulators:—

MECHANICAL SPLICE EAR. H. H. Luscomb, Hartford, Conn., 591,556. Filed July 1, 1897.
Details of construction.

Dynamos and Motors:—

DYNAMO ELECTRIC MACHINE. E. W. Farnham, Chicago, Ill., 591,623. Filed June 14, 1897.
A dynamo suitable to be placed upon a vehicle and actuated by the rotation of the wheels.

DYNAMO ELECTRIC MACHINE. E. W. Farnham, Chicago, Ill., 591,625. Filed July 19, 1897.
Adapted to be attached to a vehicle and be driven by one of the wheels.

Electro-Metallurgy:—

PROCESS OF AND APPARATUS FOR ELECTROLYTIC RECOVERY OF METALS FROM THEIR SOLUTIONS. J. W. Richards and C. W. Roepper, Bethlehem, Pa., 591,571. Filed Jan. 7, 1897.
Employs a cathode, which consists of a highly porous mass of an organic substance, the mass having its conductivity increased by a superficial and interstitial coating of an electrically conductive material.

Lamps and Appurtenances:—

CARBON HOLDER FOR ARC LIGHTS. O. S. Moss, Syracuse, N. Y., 591,486. Filed Jan. 28, 1897.
Comprises a top adapted to receive a lamp rod, and having an inner convex bearing surface, a side piece having both faces concaved, one of which is adapted to engage with the carbon, and the other with the inner face of the top, and means for holding them and the carbon together.

FITTING FOR GLOW LAMPS. F. Palm, Nuremberg, Germany, 591,490. Filed May 10, 1897.
Consists of an insulated socket provided with pressure fingers for each terminal, in combination with the naked main wires properly spaced apart.

Measurement:—

ELECTRIC METER. G. A. Scheeffer, Peoria, Ill., 591,641. Filed Dec. 9, 1896.
Employs a mercury contact in place of commutator brushes.

Miscellaneous:—

ELECTRIC DENTAL MALLET. P. Russell, New Market, Md., 591,499. Filed Oct. 6, 1896.
Comprises a helix surrounding a hollow iron core, and a mallet stem passing axially through the core.

ELECTRIC HEATER. O. D. McClellan, Philadelphia, Pa., 591,783. Filed Oct. 17, 1895.
Designed for the generation of steam.

PROCESS OF AND APPARATUS FOR ELECTROLYZING. W. Bein, Berlin, Germany, 591,730. Filed June 15, 1896.
Employs a porous diaphragm.

Railways and Appliances:—

SIGNALING ON RAILWAYS. A. C. T. Bond, London, Eng., 591,376. Filed May 14, 1897.
Employs two rails and a return; batteries connected respectively with both; contacts for rendering either of the batteries inoperative and a lever between the contacts for operating them, together with a cab electrically connected with the rails and the return, and carrying signal devices in the electrical connections.

TROLLEY WHEEL. R. S. McPhail, Toronto, Canada, 591,489. Filed May 18, 1896.
Consists in providing a hollow axle for the bearing which fits into cylindrical cups secured in the forked end of the trolley arm.

ELECTRIC RAIL BOND. W. H. Wiggin, Worcester, Mass., 591,516. Filed April 26, 1897.
Comprises a flat-sided plate having a partial, flatwise twist in its central portion, and provided with terminal studs at its respective ends.

TROLLEY. G. K. Shryock, Johnstown, Pa., 591,698. Filed April 23, 1897.
Consists of two arched springs arranged longitudinally with the car and having each a pair of rollers at its end receiving between them the body of the other spring.

ELECTRIC RAILWAY. D. Urquhart and F. Wynne, London, Eng., 591,706. Filed Nov. 17, 1896.
Surface contact system.

Switches, Cut-Outs, Etc.:—

ELECTRICAL PROTECTOR. C. A. Rolfe, Chicago, Ill., 591,426. Filed Jan. 11, 1897.
Comprises a cut-out for removing the instrument from the line; a ground circuit provided with a cut-out operating upon an excess of current therein; and means for including the ground cut-out in the ground circuit after the operation of the line cut-out.

ELECTRIC SWITCH. J. C. Cassidy, East Orange, N. J., 591,451. Filed March 20, 1897.
Details of construction.

ELECTRIC SWITCH. J. W. Parkin, Philadelphia, Pa., 591,491. Filed Jan. 21, 1897.
Adapted for controlling the operation of several lights, as an electrical chandelier.

SWITCH APPARATUS. J. P. Coleman, Swissale, Pa., 591,590. Filed July 3, 1897.
Comprises an electric motor, a resilient connection between the motor and the part to be shifted, and a make-and-break mechanism in the circuit of the motor and operated by a part of the resilient connection.

Telegraphs:—

TELEGRAPH KEY. E. W. Farnham, Chicago, Ill., 591,624. Filed July 10, 1897.
Means whereby the circuit can be closed when the key is not in actual use for sending messages, without the employment of an auxiliary circuit closer.

LEGAL NOTES

THE CONNECTICUT SUPREME COURT ON PARALLEL TROLLEY LINES.

The text of the decision of the Supreme Court of Connecticut against the Shelton Street Railway Co., given out on Oct. 11, proves to be very important in its bearing on projected parallel trolley enterprises. It sustains the lower court in its finding that the financial strength or weakness of a trolley parallel enterprise must be considered in determining the question of public necessity and convenience. On this point the court says: "In this case the only claim of such illegality is that the trial judge found as a fact that the applying railroad company was financially unable to build the proposed railroad. It seems very clear that in ascertaining such a fact the Judge did not exceed his jurisdiction. It was one of the circumstances peculiar to the case, proper to be considered in determining whether, under all the conditions then existing, public convenience and necessity required at that time the determination in favor of this applicant of the conditional right of the Naugatuck Railroad to protection against a parallel road." The court also lays down the principle that on all points covered by the statute the decision of the lower court is final.

The practical effect of the decision is to compel all projected parallel trolley enterprises which have not heretofore passed the lower courts of Connecticut to prove their financial strength before these courts will approve them.

MARRIED

STERLING—MORRIS.

We are pleased to announce the marriage on October 19 of Mr. C. B. Sterling, of New York, to Miss Julia Lindsey Morris, of Perth Amboy, N. J., daughter of Mr. Frank B. Morris, of the Lehigh Valley Railroad. Mr. Sterling is one of the rising young men in the electrical field, where his many good qualities have made him greatly liked.

TRADE NOTES & NOVELTIES

THE ERIE BALL SINGLE CYLINDER ENGINE.

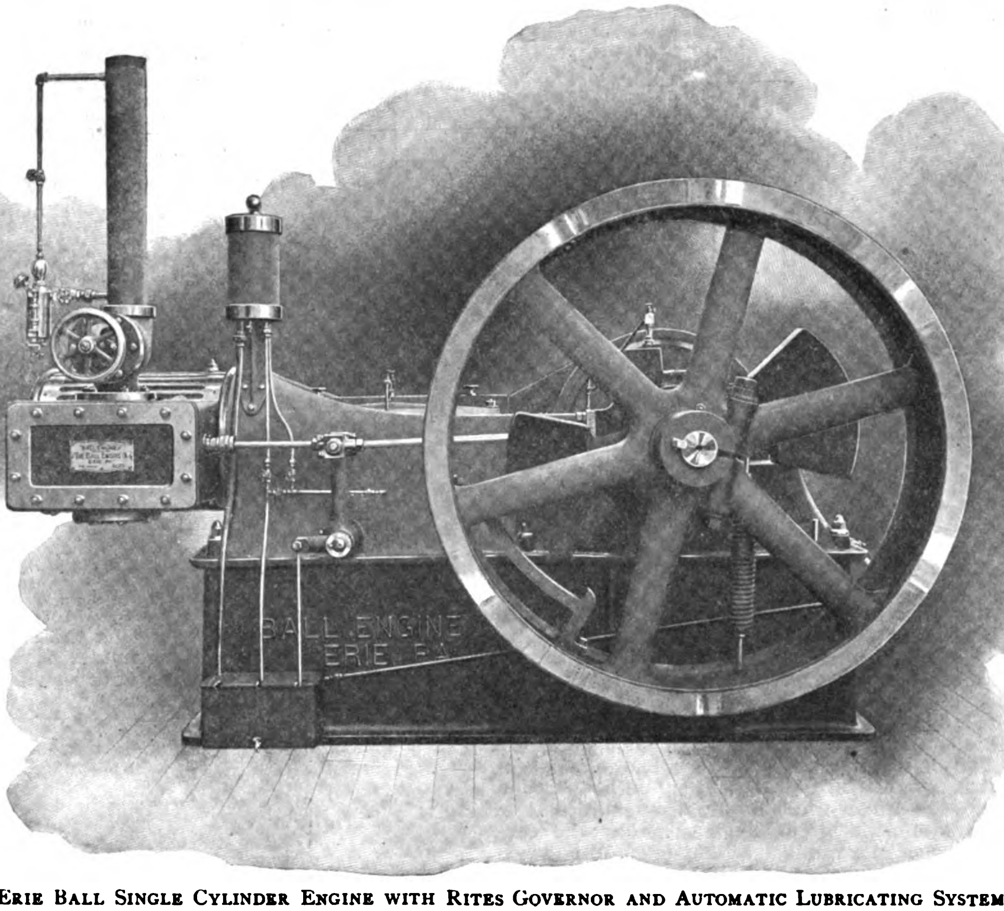
A RECORD of many years of success and its use in many electric light and railway stations in all sections of this country makes it unnecessary to introduce to our readers the "Ball" engine, built by the Ball Engine Company, Erie, Pa. Its friends, however, will be pleased to see some new features which will merit their attention.

The single cylinder engine illustrated in the accompanying engraving, is equipped with the new Rites governor and automatic lubricating system, and shows a very pleasing appearance. The governor, which has been described in these columns, is a combination of inertia and centrifugal forces, and not only regulates to the very highest degree of perfection, but with an extraordinarily rapid adjustment, and without the slightest instability or racing. It also has the advantage of great simplicity, as the entire governor consists of but a single moving piece suspended upon one pivotal point, thereby reducing friction to a minimum.

The lubrication of the engine, as shown, is accomplished by the use of the gravity system of supply to graduated sight-feeders located at the various oiling points upon the engine. This system becomes automatic through the use of a pump that is driven continuously from the valve motion, delivering oil into the tank. The pipes are so connected that direct pressure may be established on the supply pipes for the purpose of removing any obstruction that may occur.

The gravity system of oiling seems to have many advantages over the splash or direct forcing system, for in these systems in the process of elevating the oil to a sufficient height to feed over the engine, the oil becomes aerated, but in the gravity by pumping into a tank there is opportunity for the air to leave the oil, consequently each of the feeds shows clear oil.

The oil after having been distributed over the running surfaces, gravitates down to the bottom of the inside of the frame, and from there is led out to the front end of the frame and through an inclined pipe down to a receiving tank set near the floor level. Here the oil passes through one or two screens to remove any floating particles of foreign matter, and is then pumped to the supply tank above the engine in a much greater quantity than is called for to supply the engine, the surplus being carried back to the receiving tank by an overflow pipe. This arrangement insures an absolute flood of oil if desirable over the engine, as well as a supply of oil for the engine for a long run without the use of the pump.



THE ERIE BALL SINGLE CYLINDER ENGINE WITH RITES GOVERNOR AND AUTOMATIC LUBRICATING SYSTEM.

PHŒNIX CARBON CATALOGUE.

The Phœnix Carbon Manufacturing Company, of St. Louis, Mo., has just issued a new catalogue of its products illustrated with excellent engravings. First place is given to the Phœnix carbon porous cup cells for open circuit work, which have several features of great value, and that insure long life and continuity of service of the cells, which are made in various styles. We also note descriptions of the crow-foot gravity and Fuller mercury bichromatic cells, made in several sizes by the Company, as well as a special type of Phœnix porous cup cells for closed circuit work. This part of the catalogue closes with illustrations of eighteen styles of battery zincs, made by the Company.

The remainder of the catalogue is devoted to the Company's Phœnix arc light carbons, street railway motor and generator brushes, and to illustrations of a variety of carbon products such as diaphragms, discs, plates, buttons, filament blocks, lightning arresters and other products of carbon, whose use in the arts is widening daily. The catalogue will be found useful to all engaged in electrical work.

NEW C & C AGENCIES.

We are advised by the C & C Electric Company, New York, that their business has been growing so rapidly of late and numerous inquiries are coming from such a wide range of territory that they have found it advisable to establish a number of new sales offices in cities wherein they were heretofore not represented.

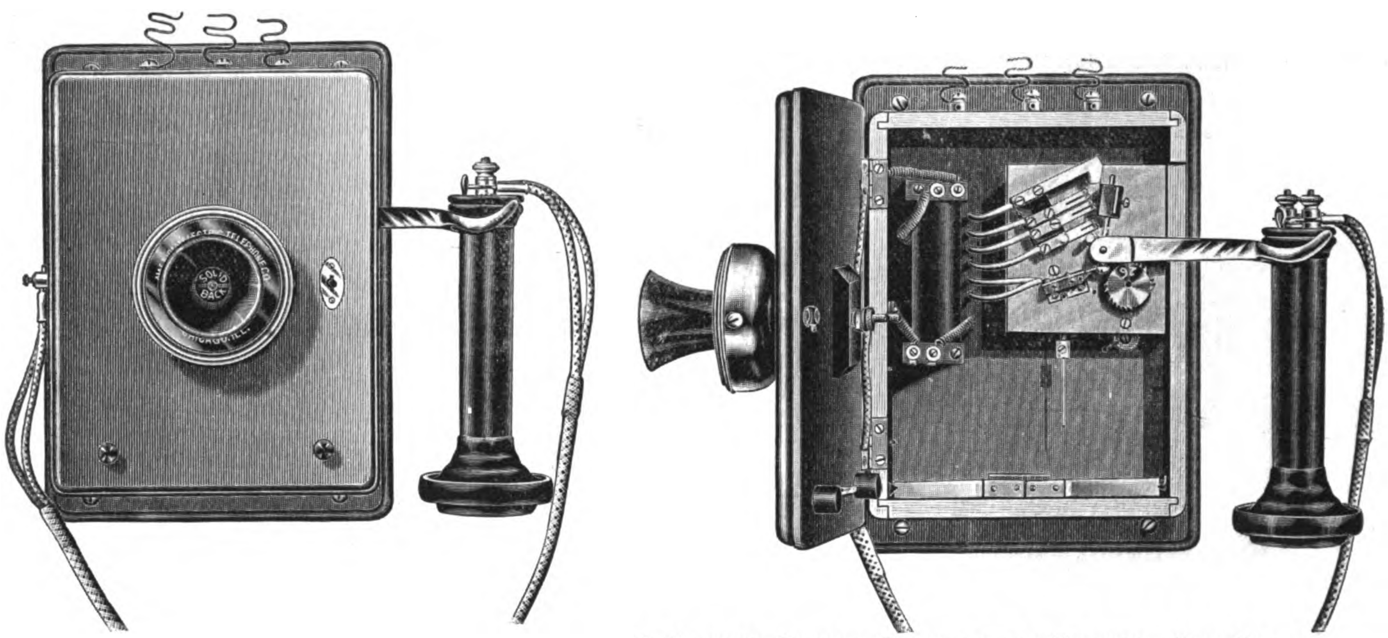
Besides recently having established sales agents in several foreign countries, they have arranged to be actively represented in Pittsburg, Pa., and Louisville, Ky. Their interests in Pittsburg will be capably looked after by L. W. Woolston &

Co., a new firm, with offices in the Vandergrift building, while Mr. J. H. Cochran, with offices in the Columbia building, will see that a fair share of C & C apparatus is sold in Louisville.

A COMBINED DISTRICT TELEGRAPH AND TELEPHONE CALL BOX.

THIS apparatus is a combination of a district messenger call box and a telephone transmitter and receiver. In the accompanying illustrations Fig. 1 shows an exterior and Fig. 2 an interior view. When the receiver is removed from the hook the number of the box desiring service is automatically signalled to and registered at the central. The telephone is then used to communicate the wants of the subscriber and obviates sending a messenger to the calling party to find out what is wanted, as with the old system.

The instrument is equipped with automatic ground connections, permitting of its operation under all conditions of wire trouble, such as short circuits, broken wire, permanent or intermittent ground escape, etc. Each box is provided with two push buttons, enabling the subscriber to establish a ground on either side of his instrument and at the same time to open the incoming wire at the binding post on the side of the box grounded. By this arrangement he can establish a complete circuit from his box over either or both wires leading to central and it renaers it possible for him to both signal his location and talk with the office under almost any circumstances.



FIGS. 1 AND 2.—AMERICAN ELECTRIC TELEPHONE CO.'S COMBINED DISTRICT TELEGRAPH AND TELEPHONE CALL BOX.

A non-listening attachment is employed, whereby the central is at once notified of the number of any would-be eavesdropper, thus insuring absolute privacy in conversation. Another good point is that the great loss and annoyance resulting from "N. G." calls are entirely eliminated. It may be seen from the foregoing that its novel features make its use desirable in hotels, factories, ocean or lake steamers and in similar places for communicating to the office the wants of patrons.

The American Electric Telephone Company, 171-173 South Canal street, Chicago, are manufacturing and have already sold many of these instruments. Of their satisfactory operation there can be no doubt, as plenty of gratifying testimonials have been received from representative exchanges throughout the country.

CENTRAL TELEPHONE AND ELECTRIC CO., ST. LOUIS.

This Company informs us that they have acquired the business of the D. A. Kusel Telephone Manufacturing Company, Mr. D. A. Kusel having sold his interest and good will in the business to Mr. R. T. Durrett, who will have charge of the financial department of the new Company, while Mr. J. S. Cuming will give his entire attention to the practical management of the business. All instruments heretofore manufactured by the D. A. Kusel Telephone Manufacturing Company will be manufactured by the new Company, though they will make such improvements as experience has taught them will elevate the standard of excellence to the highest point obtainable.

All the books, accounts and correspondence of the old Company are the property of the new Company and will remain in their possession; therefore, any reference to former correspondence will receive intelligent attention.

The Company will soon issue a new catalogue and price list, which, they say, will be the most complete of its character ever printed, and in the meantime they will be pleased to furnish revised prices on any article in their line. The Company's offices are at 1123 Pine street, St. Louis, Mo.

THE PRENTISS TIME SWITCH.

THIS device is a simple arrangement for turning off a number of incandescent electric lights at any predetermined time, and is used in connection with an ordinary clock. The peculiarity of this time switch lies in the fact that the electric light circuit is not in any way interfered with or shunted, even for the purpose of operating the switch.

As will be seen in the engraving, Fig. 1, an ordinary baby knife switch is used and the entire switch, together with the operating device, is mounted on a finely finished slate base and in such a manner as to fulfill all the requirements of the most rigid electrical installation. The operating device is fast-

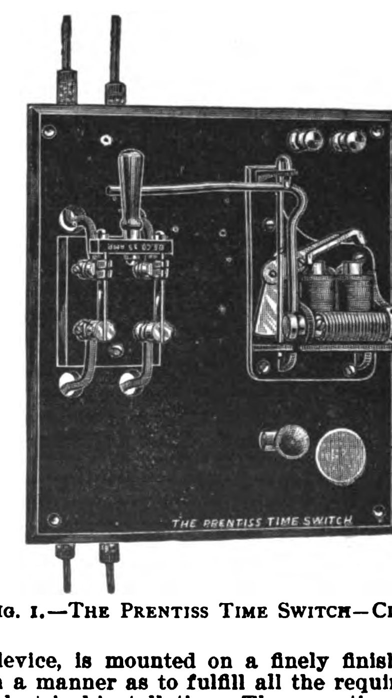


FIG. 1.—THE PRENTISS TIME SWITCH—CLOSED.

ened to the slate base at a sufficient distance from the knife switch to be perfectly safe and beyond any possibility of contact or sparking from the electric light wires or the switch proper. The operating device consists of a spiral spring in connection with an operating arm, the latter coming in contact with the handle of the knife switch in order to throw it when desired. When the lights are turned on the operating device is also adjusted so as to bring the operating arm in the position shown in Fig. 1. The little goose neck catch retains the operating arm in place and prevents the spiral spring from acting. The releasing device consists of a simple electromagnet arranged for an ordinary battery circuit and operated by means of a contact or circuit closing device attached to the clock movement and adjusted to be released and so close

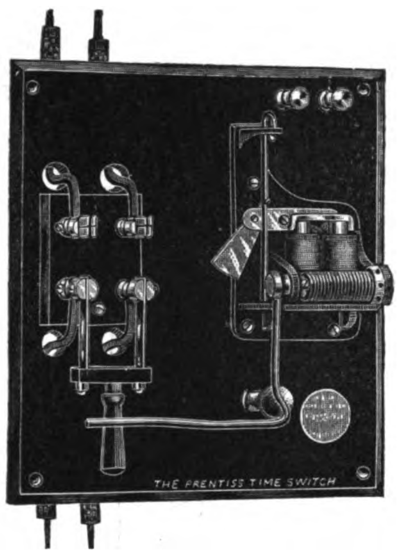


FIG. 2.—THE PRENTISS TIME SWITCH—OPEN.

the circuit at any predetermined time as may be desired. When the circuit is closed in the clock the electro-magnet is energized and its armature, in responding to the attraction, trips the catch or retaining device, allowing the spring to act, whereby the operating arm throws the switch completely over into the position shown in Fig. 2.

As the operation of the mechanism is instantaneous, no arcing can take place in the knife switch. A couple of cells of dry battery is all that is required in connection with the clock to set off the time switch. The clock may be set to operate the switch at any time desired, as already noted. If, for example, the proprietor of a store desires to keep his show window lights burning until, say, 9 o'clock in the evening, he has his clock set to go off at 9 o'clock, and when that time arrives the local circuit is automatically closed and the time switch operates, thus extinguishing his lights in precisely the same manner as would be done by hand if he stayed there until that time and threw the switch himself.

There are also a variety of other uses to which this switch may be applied, such as opening a motor circuit where a pump or other apparatus is being run and the tank or reservoir has been filled. The same device may be reversed and used to throw on the lights at any desired time, either from the clock or, as is sometimes required in a fire engine house, where the first alarm which comes in may be utilized to turn on the lights. As already noted, any kind of a clock may be used, from a cheap alarm clock to a more expensive sixty-day clock.

The circuit closer furnished is both simple and positive in its action so that the switch may be relied upon to be operated provided the clock continues running. The same device may also be used for larger switches or for heavier currents or for arc circuits if desired. The size generally used, however, is a 35-ampere switch, which is capable of carrying all the lights of an ordinary show window.

This time switch is made by the Prentiss Clock Improvement Company, 49 Dey street, New York.

THE BROWN RAIL JOINT INSTRUMENT.

THE instrument shown in the accompanying illustration was designed by Mr. Harold P. Brown for measuring the amount of current passing through the rail of an electric road and for determining the loss caused by the bonds across each rail joint. Two special, shielded Weston milli-voltmeters are enclosed in a substantial case and their dials are exposed by unfolding two arms, which form part of the top of the case. One of these arms has a single and the other a double joint, held together by substantial hinges. When both are opened, six feet of rail are included between their outer ends.

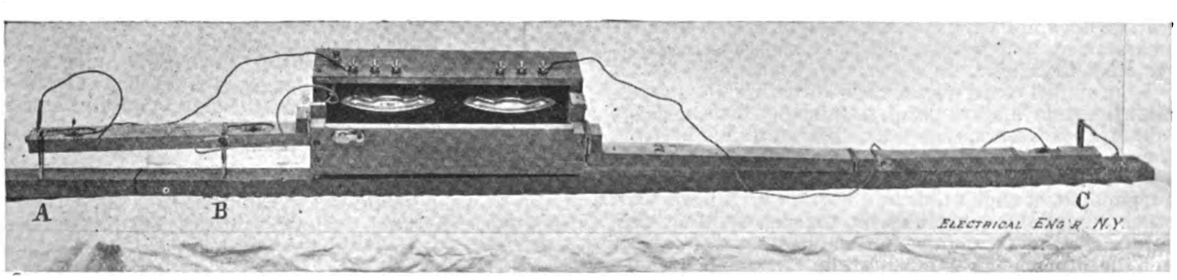
The instrument is placed parallel with the rail so that a rail joint is midway between A and B, as shown. The terminals of the instruments are connected to permanent horse-shoe magnets, which are placed on the rail so as to fit into slots in the arms at A, B and C. A and B are one foot apart and B and C are five feet apart. To insure a contact of low resistance the ends of the magnets are amalgamated and coated with the Edison flexible solder.

The instrument whose terminals lead to B and C is calibrated as an ammeter to read up to 1,500 amperes, using the five feet of rail as a shunt. If more than one size of rail is used separate resistance coils and binding posts are supplied for each size, so that the dial of the instrument has but one set of figures.

The illustration shows posts for three sizes of rail. The terminals leading to A and B are connected to a milli-voltmeter with three different coils arranged so as to read to 0.15 volt at .0001 per degree; to 1.5 volts and to 15 volts with correspondingly less sensitiveness. A contact key is used so that the circuit may be opened instantly in case an open joint is found. The arms holding the contact magnets are so strong that the instrument can be carried from joint to joint without folding up. The magnets can be quickly set up on the rails and then hold themselves firmly in position while the readings are taken. Although the importance of a rail return of low resistance is recognized by many prominent engineers, the methods used for detecting poor joints have been extremely crude and unsatisfactory.

The ordinary test is made with a voltmeter reading up to three or five volts, with pointed terminals which are scratched on the surfaces of two adjoining rails. If the reading is not high the bond is pronounced good. But if there is no measurement of current and if the rail happens to be entirely dead, the reading is zero and the bond is pronounced excellent. Some railway electricians consider that the rail return is in good condition if they find the lamps are not too dim, overlooking the fact that the pressure may be kept fairly high by crowding on more dynamos at time of heavy load, but at the expense of large transmission losses. As from 20 to 60 per cent. of the electrical power developed can be wasted by poor rail returns, any large railway will find it worth while to keep an inspector at work with one of these instruments. The one shown in the illustration was made for the Consolidated Traction Company, of Newark and Jersey City, N. J., and it is intended to equip each division with a similar one. Every joint will then be tested and a record kept of the current flowing through the rail and the loss of pressure at each bond.

The results will be recorded on a map so that each faulty joint can be afterward identified and repaired. To do this rebonding without disturbing the pavement or delaying the traffic, a car is equipped with a motor and flexible shaft and will be sent out at midnight.

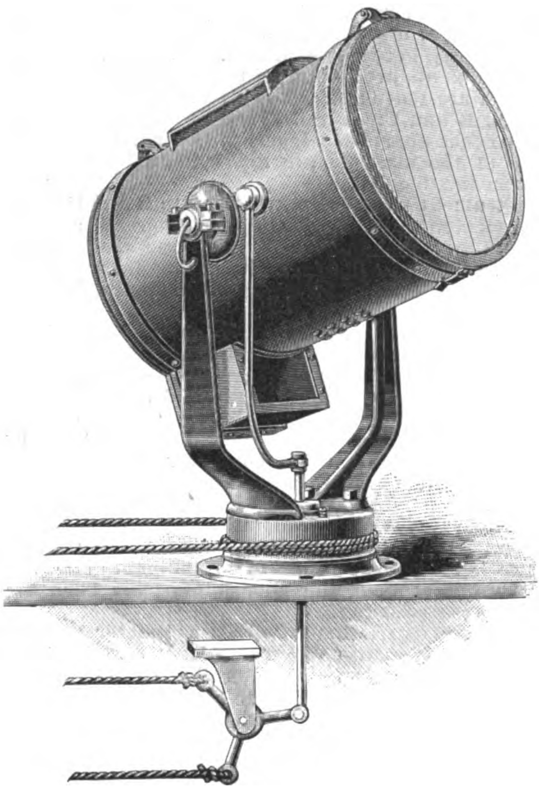


BROWN'S INSTRUMENT FOR MEASURING RESISTANCE OF RAIL JOINTS.

By means of a hardened steel template, two intersecting vertical holes seven-eighths of an inch in diamater, are bored in the tram of the rail so that the holes form a figure 8, with the halves in different rails. The holes are then amalgamated and the E. C. A. bond is driven into place and fastened. A joint bonded in this way will carry 1,500 amperes with a loss of but .018 ampere. This method of testing and rebonding quickly proves its value by cutting down the current required to operate the road and greatly reducing the cost of fuel.

THE CARLISLE & FINCH SEARCH LIGHTS.

THE search light, once considered a luxury and an amusing toy, except in warlike operations and in lighthouses, has now become a recognized valuable adjunct to marine operations both on the high seas and on inland waters. Among those who have devoted special attention to the building up of marine search lights are the Carlisle & Finch Company, of Cincinnati, Ohio, whose "Form 2" search light with steering gear is shown in the accompanying engraving.



Carlisle & Finch Searchlight.

In this search light the carbons are placed horizontally, the positive carbon being furthest from the reflector, thus throwing an intense cone of light on the reflector from the crater. The carbons are fed together by means of a right and left screw, and the actuating mechanism is such that the sensitiveness of the lamp is independent of the friction of the moving parts. In other words, the arc will be maintained at the proper length, no matter how dirty and clogged up the moving parts may become. With a good quality of carbon the voltage across the arc does not vary 2 volts. The entire weight of the lamps is carried on ball bearings in the base, thus making it exceedingly easy to handle.

This lamp is provided with means for directing its movement from pilot house or distant point, and is the form of light mostly used on river steamers, where it is placed at the bow of the boat. The engraving shows the arrangement of the steering gear. The cables for the vertical and horizontal movements are independent of each other and require no differential pulleys or other complicated mechanism for maintaining the relative positions of the two movements. Pulling one cable will not affect the other. The lamp may be swung in a complete horizontal circle, and the vertical elevation is about 90 deg.

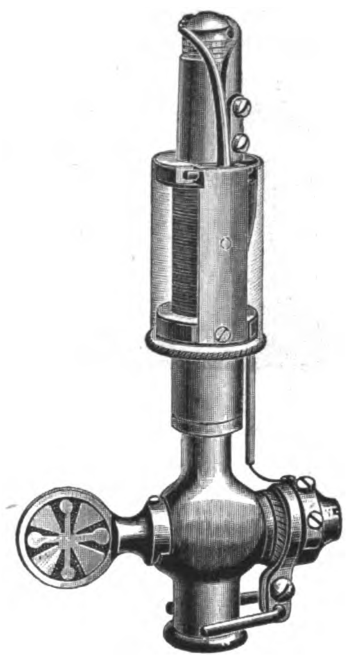
The popularity of the Carlisle & Finch search light is evidenced by the repeat orders received by the firm from previous users. They have also shipped a number for use on the Yukon River, running to the Klondike gold fields. They are now making up a large order in which the lamp cases are finished in Russia iron, with heavy cast brass ends polished.

THE WALKER ELECTRIC GAS LIGHT BURNER.

THE accompanying engraving illustrates a new type of electric gas lighting burner possessing a number of valuable features. Among these are the important and valuable qualities that the burner will relight if accidentally put out. No chains or levers are employed, the burner being operated entirely from the thumb cock.

As will be seen the burner is very simple in construction, consisting of an electro-magnet to vibrate an armature that produces the sparks to ignite the gas when the thumb cock is turned on enough for the gas to flow. The switch is constructed to light the gas whenever there is any gas flowing to the burner to light, no matter in what direction the thumb cock is turned; no matter if the check pin has come out, so long as the valve can be turned all the way round it will light when there is gas flowing to light.

The valve, or thumb cock, when turned on enough to allow any gas to flow turns on the switch that starts the electric current from the battery at the same time, thereby causing the burner to generate sparks which light the gas. The heat from the lighted gas then breaks the electric circuit almost instantly by heating a thermostat attached to one of the electrodes on the burner. Thus, it will be seen, that but little battery power is required to operate the burner.



The Walker Safety Electric Gas Lighting Burner.

Should the gas be accidentally extinguished or blown out in any way the thermostat cools in a few seconds and closes the circuit, and the valve and switch being already turned on, the burner begins to spark just as if turned on by hand, and relights the gas, the heat from which again breaks the sparking circuit.

The burner can be put on to any fixture with any kind of shade holder, and can be used as a candle burner if desired. The switch can be attached to any thumb cock and is simple and neat in appearance and construction. If the house is already wired for gas lighting, the same wires and battery will operate the burner.

This ingenious gas lighting burner is manufactured by Messrs. William L. Walker & Co., of 620 Atlantic avenue, Boston, Mass., who want enterprising agents in every city and town.

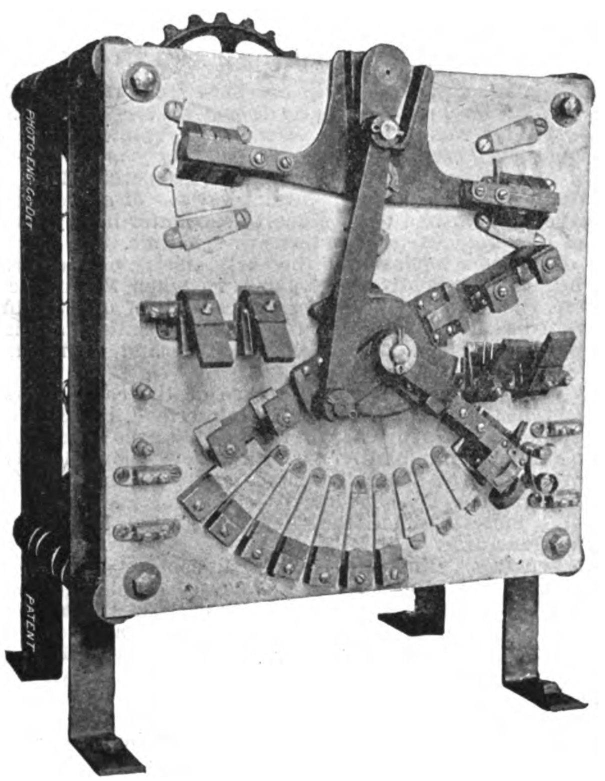
THE ELECTRIC ARC LIGHT COMPANY, manufacturers of the Pioneer enclosed arc lamp, have moved their offices to the American Tract Society building, 150 Nassau street, New York. Mr. W. C. Hubbard has been elected secretary of the Company.

THE ELECTRIC STORAGE BATTERY COMPANY has a contract for a battery plant for the lighting of Princeton University, and another with one of the street railway companies of Baltimore for a plant similar to the one of the Union Traction Company, of this city. An order has been received from a steam railroad for the equipment of fifty passenger coaches with the electric storage system for lighting purposes.

THE SCHNEIDER AUTOMATIC MOTOR STARTERS.

THE accompanying engraving illustrates the style C Schneider automatic motor starter, manufactured by Messrs. Thos. Muir & Son, 31 Larned street West, Detroit, Mich. This motor starter is specially designed for controlling single belted, direct driven or reversible elevator motors, traveling cranes, ventilating fans, etc., while leaving out the reversing switch makes the apparatus available for regulating speeds of ventilating fans and other motors running constantly in one direction.

The controlling rope passes over the toothed wheel shown at the top, and when operated to start the motor the main D. P. knife switch is thrown in and held in contact by a magnetic lock. This magnet at the same time releases the rheostat arm, which (being controlled by a coil spring and fan mechanism) is moved forward at a regulated speed over the segments, thus cutting out resistance. The rheostat arm here contacts with



SCHNEIDER AUTOMATIC MOTOR STARTER.

a post which may be wired for pilot lights in the elevator. The motor is shut off by a reverse pull of the rope, which carries back the rheostat arm to zero, and in doing so opens the main switch and winds up the coil spring.

Any failure of current, from any cause, allows the magnetic lock to release the main knife switch and gives absolute protection to both the motor and starter. The rheostat arm must again be pulled back to zero point before the motor can be started; but this movement is under the control of the operator.

The magnets for opening the main switch on overloads and open circuit are adjustable. The main switch and rheostat contacts have carbon breaks, while all current carrying contacts are of copper, of ample capacity. The speed can be regulated at any point on the rheostat beyond the fourth contact.

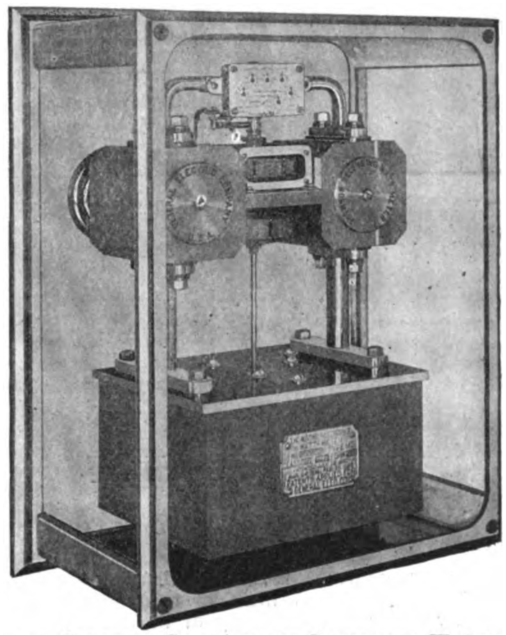
GENERAL ELECTRIC G-2 ASTATIC RECORDING WATTMETER.

THE construction by the General Electric Company of a recording wattmeter of sufficient capacity to measure and register the total output from the generators in central railway or lighting stations, met a demand, created by the new conditions of electric practice. The character of this demand may be gauged by the fact that a recording wattmeter which three years ago would have been regarded as of enormous capacity, is to-day considered small. Meters of 10,000 amperes are now commonly called for, while inquiries have been made for sizes registering as high as 16,000 amperes.

Measurement of these heavy capacities precluded the use of any form of wound meter field, and the Thomson recording wattmeter had necessarily to be modified. Furthermore, the rapidly growing tendency to set the bus bars closer together, and bring the switchboard into the least possible space, has rendered it advisable that large meters of this character, where intended for boards of modern construction, should be astatic.

While on the majority of switchboards an astatic wattmeter is not necessary, there exist cases in which the best metering results could not be obtained without one; and that total station output meters might be applicable alike to all switchboards, whether within heavy projected fields or not, the G-2 meter has been designed and is manufactured in an absolutely astatic form.

In these the field is a single straight bar of forged copper, above and below which are placed two armatures arranged as-



GENERAL ELECTRIC G.-2 ASTATIC RECORDING WATTMETER.

tatically, and having a common commutator. The damping device is also double and astatic, the polarities of the upper and lower group of damping magnets being opposite. The damping mechanism being enclosed within an iron shielding box, any stray leakage lines of an unbalancing character are prevented from entering. The G-2 meter is so independent of local or stray influences that it may be installed directly in front of the very heaviest busses without the introduction of any inaccuracy.

The entire meter, shown in the accompanying illustration, is held in position upon the switchboard by two studs, which form at once the electrical connections and the mechanical support of the instrument. These pass through the board and are bolted to the bus bar by binding nuts with large contact surfaces. The cover is of beveled glass set in a polished brass frame fastened to the board.

NEU'S ELECTRICAL TELL-TALE TANK FLOATS.

THERE is scarcely a building of any size erected nowadays, whether for private residence or office or business purposes that is not provided with a water tank connected with a pump in the engine room. As interruptions to the service of the water from the tank may lead to dangerous consequences, as in case of fire, and are at all times a source of annoyance, some device is desirable to indicate the height of water in the tank.

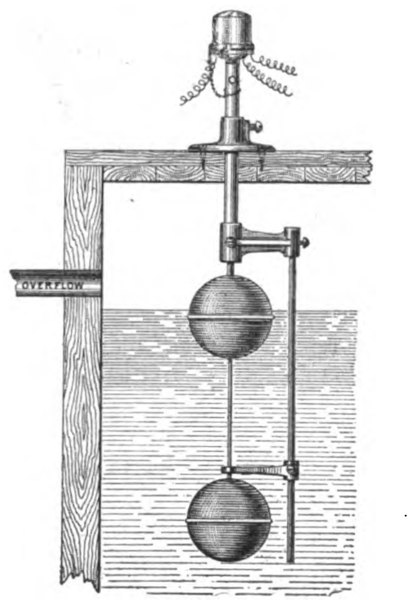
Mechanical tell-tales designed for this purpose work fairly well if the distance between the tank and the pump room is not great and there are no corners to turn, but if the tank is on the roof of the building and, consequently, at a considerable distance from the pump room, something more sensitive and reliable is needed. Evidently an electrical device is the one par excellence for meeting the conditions.

A very simple and ingenious device of this kind is the electric tell-tale float manufactured for various purposes by Mr. G. S. Neu, of 145 Centre street, New York.

The accompanying engraving shows the Neu high and low water float for closed tanks. As will be seen, it consists principally of two floats, arranged on a rod in such a manner that when the water rises too high the upper float is pushed up, thereby closing the circuit and causing a bell in the engine room to ring. In the same way, when the water falls below

the lower float the float descends until the circuit is completed and an alarm given as before. These floats can be so placed as to give alarm if the water varies a few inches, or they can be placed as, in one order filled by Mr. Neu, where the range of rise and fall was no less than 65 feet.

The use of the Neu tell-tale alarms is by no means confined to water, it being used for acids, in breweries, distilleries, tanneries, refineries and, in fact, they can be used wherever tanks or vats are employed, their portability allowing of their



NEU'S ELECTRIC TELL TALE TANK FLOAT.

being used in many situations, at practically no extra expense. They can be moved from tank to tank as they are being filled, thus avoiding the necessity of stationing some one at the tank to watch it when filling.

Mr. Neu also makes similar floats for high and low water alone. He has a large number of endorsements of the efficacy of his products from insurance bodies, fire protective companies and many users.

THE LOCKE HIGH TENSION INSULATORS.

IN a patent issued to Mr. Fred M. Locke, of Victor, N. Y., the inventor describes a method of constructing insulators, possessing special, high insulating properties.

Insulators heretofore have been constructed higher than

LOCKE'S HIGH TENSION INSULATORS.

they are broad, but Mr. Locke has found that these insulators have been defective owing to their short diameter and spread. He has, therefore, found in actual practice, that it is necessary to increase the spread with respect to the height, and this for two reasons: First, the increase of its efficiency as an insulator, and, second, that it allows of the use of a shorter, and therefore a stronger, insulating pin, which is particularly desirable in high-voltage power transmission.

Mr. Locke has observed that in the ordinary insulators, as above described, the edge comes so close to the supporting pin or the support upon which it is mounted that the current arcs from the edges of the insulator to the pin or support upon which it is mounted. To obviate this difficulty he has constructed an insulator as broad or broader than it is high and provided it with one or more skirts or petticoats, as shown in the accompanying illustrations.

In one of the forms illustrated Mr. Locke also provides the insulator with a bead or trough upon its periphery to conduct the water to certain points, so that the dripping will take place at points remote from the support upon which the pin is mounted. He is thereby enabled to prevent the water from accumulating upon the entire lower edge of the outer skirt, which would otherwise form a conductor for the current, which, when it had passed around the point nearest the support, would otherwise arc across.

Insulators of this "helmet" type are employed on the Niagara transmission to Buffalo and on the Lachine transmission to Montreal.

ACETYLENE GAS; ITS HISTORY AND UTILIZATION.

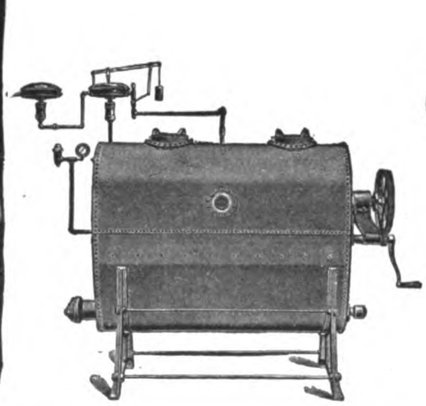
THIS is the title of a little brochure from the pen of Dr. W. H. Birchmore, recently issued by Messrs. J. B. Colt & Co., 115-117 Nassau street, New York. Volumes have been written about acetylene during the last few years, but we are bound to confess that Dr. Birchmore has succeeded in incorporating more useful facts regarding the use of acetylene than we have thus far had the fortune to encounter in any publication of the same size, either trade or scientific.

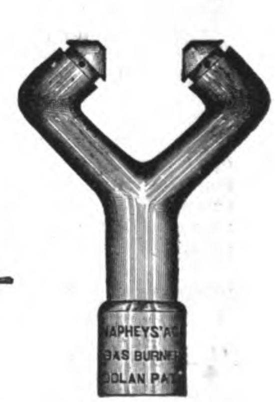
Dr. Birchmore begins with the early history of the carbides and brings one rapidly up to the time when Maquenne and Moissan succeeded in obtaining the carbide of calcium in the electric furnace. It remained for American enterprise and invention, however, to give calcium carbide and with it acetylene, a commercial value.

The simple method of manufacture of the carbide and its preparation for the market are then described, bringing us up to the question of generators for developing the acetylene gas for use as an illuminant. Dr. Birchmore shows how these generators may be generally classed as "wet" and "dry" ones. The latter alone he considers practical for general use and describes more in detail the "dry" apparatus, known as the Naphey generator.

The generator, illustrated in Fig. 1, consists of a drum of sheet steel, depending on the amount of carbide to be held for size. Within it is a receptacle for carbide and a spraying apparatus. Into this drum are made two manholes, one to supply carbide, the other to take out the waste. Three pipes also enter, one to carry in water, another to give exit for the gas, while a third is used to remove any water which may appear needful to use in cleaning.

There is also mechanism for turning over the charge of carbide, which once in a while may be desirable or needful. Connected with the drum are two valves, one for the control of the water, the other to control the pressure of the gas at the





FIGS. 1 AND 2.--NAPHEY ACETYLENE GENERATOR AND BURNER.

burners. A pressure-gauge and a blow-off are also furnished. The pressure of the gas within the drum exactly and automatically controls the water supply.

Having obtained a practical generator, the next thing to do was to get a good burner. The Naphey burner, like the generator, we are told, fills all requirements, being a burner with two tips in which the mutual action produces a flat flame, and in which the holes are straight and round so that they can be

readily cleaned. Dr. Birchmore also discusses the luminous and spectral qualities of the flame, as well as its hygienic attributes. As regards the cost of acetelyne, Dr. Birchmore presents the following calculation:

One pound of the calcium carbide of commerce will give under the conditions of use in a properly constructed "dry generator," not very far from 4.48 cubic feet of acetylene. This is the average amount from a very large number of experiments. Burned in a half-foot burner this is nine burner hours per pound of the carbide of commerce. Such a burner will give 25 c. p., and it therefore follows that a pound of carbide of commerce will give 225 c. p. hours. Five cubic feet of standard illuminating gas per hour burned in an Argand burner will give 16 c. p. hours. To give the same number of candle-power hours as the pound of carbide, one must, therefore, use the amount of gas represented by the expression, $225 \div 16 \times 5 = 70\frac{1}{3}$ cubic feet.

At the ruling price of gas, $1.25 per thousand cubic feet, 70$\frac{1}{3}$ cubic feet cost a fraction less than 9 cents, 8.79 cents, to be accurate. In other words, the acetylene can enter the competition, on fair field and no favor principles, at a price a fraction less than 9 cents a pound, or at $175.75 per ton of 2,000 pounds. The present ruling price of carbide is $70 a ton of 2,000 pounds.

Of the dangers of acetylene, Dr. Birchmore makes light, asserting that the accidents that have occurred were due to carelessness.

The little booklet is well worth a perusal by all who desire to be posted on acetylene and its possibilities. Messrs. J. B. Colt, who issue it, are the sole American agents for Naphey's acetylene gas generators and burners for illuminating purposes. They will gladly send the booklet above referred to on application.

J. H. BUNNELL & CO.'S SIXTEENTH ANNUAL CATALOGUE.

The Bunnell catalogue has long been acknowledged as a standard trade publication. This year's edition, the sixteenth, is even more comprehensive and valuable than its predecessors. It contains considerable new matter not furnished in previous issues and will be found interesting, not only as a book of reference in regard to the latest prices, but also as a most complete list and description of all that is newest and best in telegraphic and electrical apparatus and supplies.

Bunnell & Co.'s specialties are too well known to require any detailed mention of the thousand and one things to be found between the covers of the new catalogue. Suffice it to say that every electrical worker or experimenter will discover in it something that he requires. All articles enumerated have the price given, and the grouping and arrangement is such that "finding the article wanted" is extremely easy. "Finding" is also made a certainty by the unusually comprehensive index at the end of the catalogue. The front cover shows a fac simile of the diploma awarded to Bunnell & Company, at the Columbian Exposition, and the whole book is got up in neat style, the illustrations numbering over eight hundred! The catalogue can be had on application.

THE MAINTENANCE COMPANY.

The introduction of electric lighting plants in many modern buildings, both public and private, has thrown upon the engineers in charge responsibilities for which they are rarely prepared. The result is that even with the best of intentions the apparatus, frequently from sheer ignorance, is allowed to deteriorate, and ending often in breakdown and its accompanying annoyances and cost for repairs. In the majority of such cases an intelligent inspection and small, timely repair would avoid all such troubles. It is therefore a matter of importance to owners of buildings to have their plants regularly inspected and maintained in good condition by experts, and one of the pioneers in carrying out such a plan is Mr. Jas. J. McKenna, president of The Maintenance Company, St. Paul, Bldg., 220 Broadway, New York. Mr. McKenna's plans from the start were based upon the assumption that to make a success of such an undertaking, it was necessary that the interests of the owner of the electrical apparatus, the manufacturer, the engineer (or other person in charge of the plant), and the company issuing a contract thereon, should be blended. These facts constituted what might be called the foundation stones of the business.

The Maintenance Company was incorporated through the efforts of its treasurer, Mr. Ernest R. Bartlett, and Mr. McKenna, with a capitalization of $100,000, for the purpose of carrying on the maintenance business, upon the lines as heretofore practiced by Mr. McKenna. The company has for its board of directors the following well-known gentlemen: Mr. Louis Heck, of the Stucky & Heck Electrical Manufacturing Co.; Mr. Allen D. Loney, of the banking firm of Lathrop R. Bacon & Co.; Mr. Bradish Johnson Carroll, president of the Duval Metallic Packing Co.; Mr. H. Hobart Porter, late of the Westinghouse Electric Manufacturing Co., and now of the firm of Sanderson & Porter; Mr. Ernest R. Bartlett, who has been well and favorably known in connection with the maintenance idea from the time it was first introduced to the public; Joseph M. Cooper, of East Orange, N. J., and Mr. J. J. McKenna.

Engineers, manufacturers and owners of plants throughout the various sections to whom this subject has been introduced, to-day concede the necessity of such an undertaking, providing it is done in a practical and judicious manner. The company goes forward with every expectation of success, and with a full and intimate knowledge of this particular business.

THE STANDARD AIR BRAKES.

The Standard Air-Brake Company again appears at another street railway convention. It was in evidence at the World's Fair in 1893, at the Atlanta convention in 1894, Montreal in 1895, St. Louis in 1896, and now appears for the fifth year. We have illustrated the Company's well known type of apparatus from time to time in these columns. Managing Director Wessels states that the "Standard" system is now in such desirable shape as to make it unnecessary to introduce any new features. The Company still holds to its well known type of axle-driven compressors, which are furnished both single acting and double acting. There are many hundreds of them in daily service in all parts of the globe, and the prophecy that Mr. Wessels uttered three years ago has been practically verified: "Where'er you go the wide world round, the Standard air-brakes will be found."

Business this year is reported as being not only very satisfactory, but decidedly in advance of previous years, and while the Standard Air-Brake Company's foreign business has undergone considerable expansion since last convention, the business in the United States has also seen a decided increase, and numerous installations have been made East, West and South. It has required a great deal of determination and business ability for the Company to maintain its position as the first in the field.

One of the secrets of the Standard Company's success is the indefatigable work which the general manager puts into "driving things." Associated with Mr. Wessels on the board of directors are several international bankers and these combined names in the market place are a sufficient guarantee that all promises made by the Company will be strictly carried out. Ever since its start the Company's inflexible rule has been to pay spot cash for all its purchases. This has given them enormous advantages and enabled them to lay in raw material at such favorable prices as to admit of selling air-brakes on as low a basis as was consistent with a reasonable profit. The Standard Air-Brake Company's foreign representatives stand in the very front rank and embrace such concerns as Messrs. Dick, Kerr & Co., limited, of London, Bergische Stahl-Industrie, of Berlin, Germany, and Messrs. Noyes Brothers, of Sydney and Melbourne, Australia.

The Company made a fine display of its apparatus in Niagara Falls and in addition to having its latest motor compressor in operation in connection with its automatic controlling device, the Company referred delegates to thirty of its air-brakes now in their third year of successful operation on the Niagara street division of the Buffalo Railway Company. These brakes have had considerable to contend with, especially in the winter time, with the violent fluctuations in temperature and slush and ice. Nevertheless, they have done very well and are not only in active service, but apparently good for much longer life.

ADVERTISERS' HINTS

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, Ill., say their "F. & L." motor knife switches cut the price of anything on the market in the line of a serviceable low priced motor switch.

THE SOLAR CARBON AND MANUFACTURING COMPANY, 339 Fifth avenue, Pittsburg, Pa., manufacture carbon specialties, including battery cylinders, telephone transmitter carbons, brushes and arc light carbons.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, claim as high commercial efficiency for their dynamos as that of any generator on the market.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, 171,173 South Canal street, Chicago, Ill., advertise telephones and switchboards and call attention to their leader, No. 33, outfit. They state that there are now 400 exchanges using their instruments, aggregating 80,000 telephones.

THE REPLOGLE GOVERNOR WORKS, Akron, Ohio, advertise their new relay returning governor as representing the most efficient, accurate and satisfactory type of water wheel governor ever placed on the market.

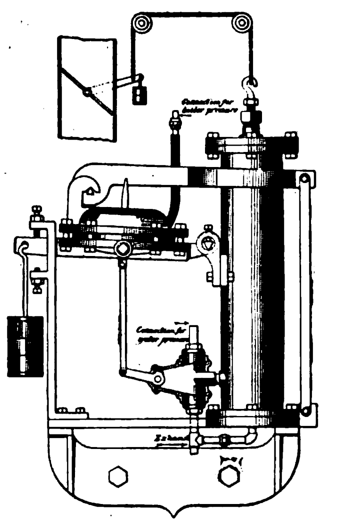
THE ANCHOR ELECTRIC COMPANY, 71 Federal street. Boston, Mass., observe that a long argument is unnecessary to demonstrate the superiority of the Anchor flush switches, in which perfection of design and excellence of material are combined.

THE CREAGHEAD ENGINEERING COMPANY, Cincinnati, Ohio, illustrate their "ad." with a large variety of overhead line material, arc light specialties and the Creaghead flexible brackets.

THE KIELEY & MUELLER IMPROVED CLIMAX DAMPER REGULATOR.

One of the recognized, best fuel savers is a good damper regulator. Messrs. Kieley & Mueller, No. 11 West 13th street, New York, are the manufacturers of the Improved Climax damper regulator shown in the accompanying engraving. It is characterized by its extreme sensitiveness.

The cylinder is lined with composition metal to avoid rust; the valve is operated from center of diaphragm casing, and it is claimed to be the only regulator wherein the diaphragm casing moves up and down, corresponding with the increase and decrease of the steam pressure, and conveying to the valve the necessary motion to cause it to let the water into



KIELY & MUELLER IMPROVED CLIMAX DAMPER REGULATOR.

and out of the cylinder. This peculiar, though advantageous construction, imparts to the diaphragm casing itself all the motion required to operate the valve.

As will be seen in the illustration, the damper in the flue is closed by the downward motion of the piston. It is therefore necessary to apply sufficient weight to the damper lever to cause it to open the damper, and at the same time pull up the piston, which it will do immediately after a slight reduction in the steam pressure, which causes a downward movement of the diaphragm casing, and a corresponding movement in the valve, whereby the inlet port is closed and the exhaust port opened. This allows the water in the cylinder to escape, thus enabling the weight on the damper lever to open the damper, and at the same time pull up the piston. In this position the damper will remain until the steam pressure increases slightly, which causes an upward motion of the diaphragm casing, the corresponding motion in the valve causing the exhaust port to close and the inlet port to open, through which the water enters the cylinder and drives the piston down, thereby closing the damper. This operation is repeated as often as occasion may require.

When desired, a graduating attachment, to cause the regulator to open and close the damper gradually, is furnished.

Messrs. Kieley & Mueller have a large number of splendid testimonials on their Improved Climax damper regulator. One enthusiastic user says: "It makes the steam gauge ashamed of itself."

"STEREOPTICON LEADERS."

This is the characteristic title assumed by the firm of Chas. Beseler's Son, 218 Centre street, New York, who manufactures all kinds of lanterns arranged for oil, lime and electric lights and also makes high grade air and gas compressors, extra quality of oxygen and hydrogen gases, and, in fact, everything pertaining to the stereopticon and magic lantern.

More than twenty years ago the business was established by Mr. Chas. Beseler, who has since then been recognized as among the authorities in his line of business, as he was a skilled mechanic and supervised the workings of his factory personally, and also those of his office, which had won for him the highest esteem from all with whom he came in contact.

After his father's death Mr. Emil H. Beseler succeeded him in the business. His excellent training and natural adaptability to the business insures for purchasers of lanterns the best, latest and cheapest, as only the most killed mechanics are employed, all of whom have served the older Beseler for many years.

The Board of Education of New York, Columbia College and many other prominent institutions are using apparatus made by this firm, with entire satisfaction and success.

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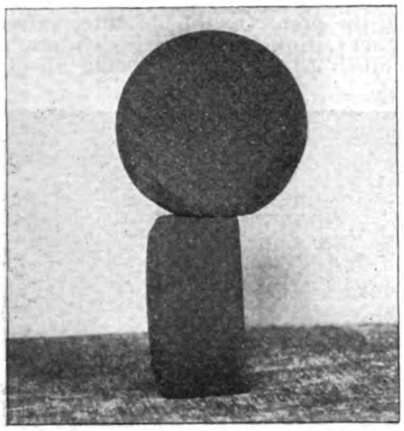
Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. OCTOBER 28, 1897. No. 495.

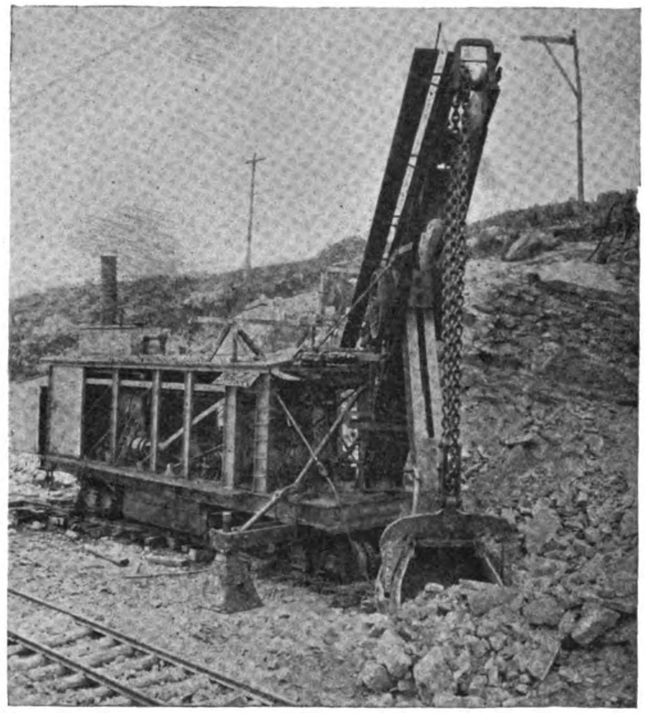
MISCELLANEOUS

MR. EDISON'S IRON ORE-MILLING WORK IN NEW JERSEY.



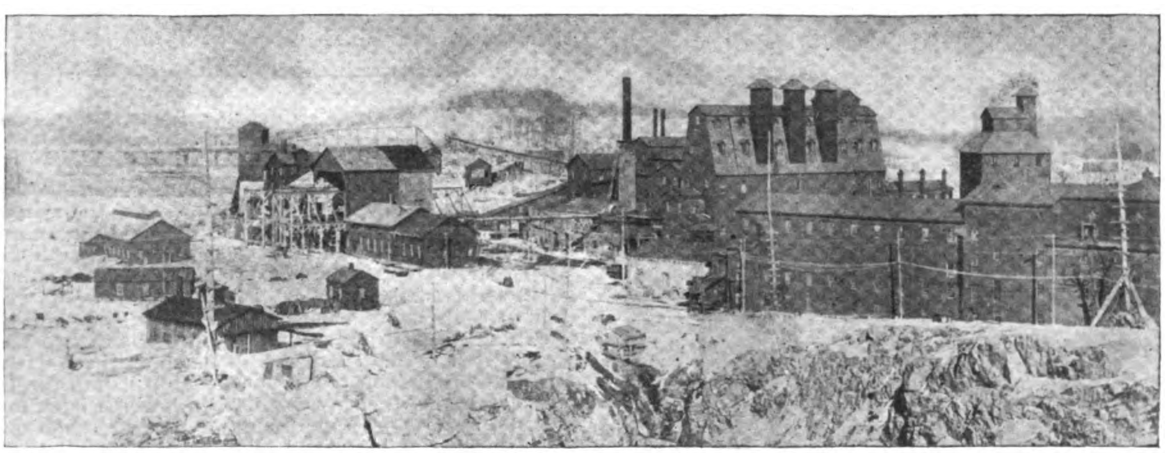
Two of the Edison Ore Briquettes.

THE extraction of iron ore magnetically, where the conditions were at all favorable, has been a process long known in the mechanical arts, and not a little of the early study and advance in magnetism was due to the desire to perfect apparatus which should so simplify and cheapen the production that even the leanest deposits of magnetic ore could be worked profitably. Patents dealing with the subject run back through many years and the litigation of magnetic ore separation has been a long one. Perhaps the most interesting chapter of history in this field, for the public in general, is that due to Mr. Thomas A. Edison, who, cogitating over the subject while still a youthful operator, may be said to have turned his energies seriously toward the subject as soon as he had satisfied himself that the foundations were firmly laid for the new art of incandescent lighting. No one thing at any time ever fully occupies the ceaseless activities of that great inventor, but it may be questioned whether during the last five years any other problems have equaled in interest to him those connected with magnetic separation. Hitherto no details of consequence have been given out, but he and his associates have been spending money freely to acquire the workable ore deposits, then to treat them on a large scale of technical and commercial success, and lastly to market the various products that result from the treatment. The appearance of the present article marks, therefore, the reaching by Mr. Edison of a stage at which he sees the goal of his hopes well in view and touch; and while the data and illustrations we are here permitted to give cannot be taken as final for one whose motto is forever, "Improve," they must be broadly characterized as of a most interesting character, and as revealing the furthest attainment of human effort in one vital and important direction of cheapening the cost of that invaluable and indispensable material, iron. It should be noted incidentally that in regard to some points, Mr. Edison prefers for the present not to give out all the information desired, many of his methods and "wrinkles" representing trade secrets bought with hundreds of thousands of dollars, years of hard work and endless series of innumerable experiments.



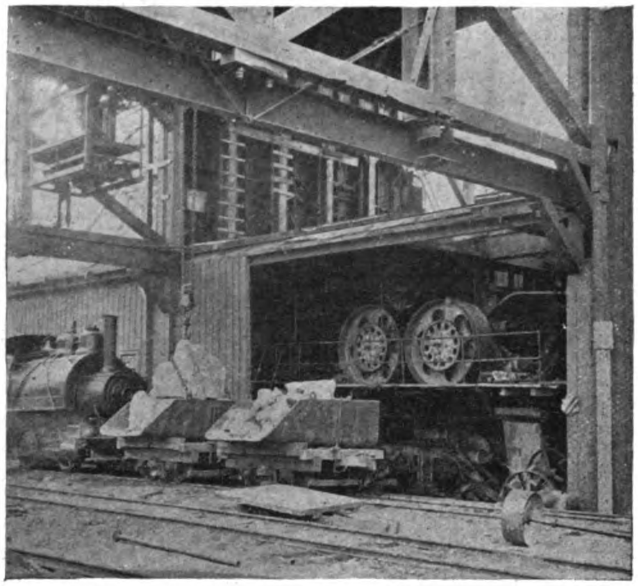
ONE OF THE BIG STEAM SHOVELS AT AN ORE VEIN.

Out in the mountains of middle Jersey Mr. Edison is now doing his chief work in magnetic separation, but other plants are projected, and the properties of the New Jersey & Pennsylvania Concentrating Works cover many square miles in various States, East, West and South. The veins near the works at the place now appropriately called Edison, not far from Lake Hopatcong, are known by careful tests to contain over 200,000,000 tons of iron rock suitable for crushing. The combined length of all the six veins there is said to be 21 miles, of an average width of 750 feet. The dip is nearly vertical, and the known depth of the ore-bearing rock is 600 feet, while tests made by Mr. A. E. Kennelly indicate a depth



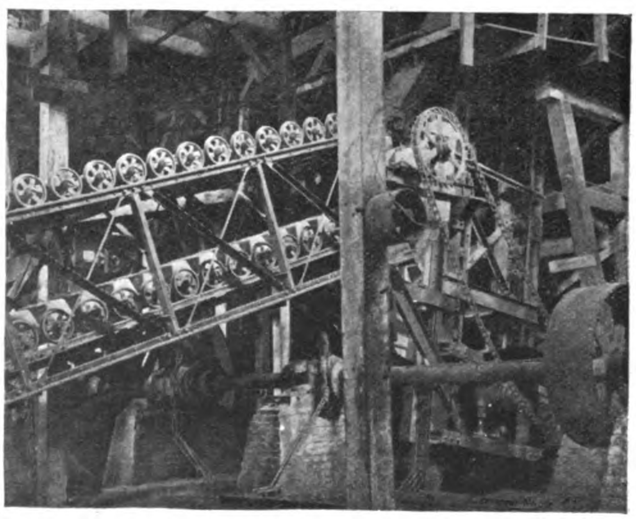
GENERAL VIEW OF ORE CONCENTRATING WORKS AT EDISON, N. J., NEAR LAKE HOPATCONG.

exceeding one mile. From these figures some idea can be formed of the possibilities of continuous production, on a large scale, for a few generations to come. A steam railroad running right into the plant puts it in direct touch with an enormous iron-making market only 100 miles away. The rock is magnetite in a feldspar gangue, containing about 25 per cent. of oxide of iron, and it can be crushed with so much ease that



Bringing Rock to the First Crushing Rolls.

Mr. Edison says the Almighty put it there for just what is now being done. The enterprise under prevailing conditions is rendered possible largely by its location, all other sources of Bessemer ore being so remote—Lake Superior, 1,200 miles; Cuba, 1,600; Spain, 3,800, or Africa, 4,300. Not only are the freights, however, fighting on Mr. Edison's side, but it is even said that to move 300,000 tons of Lake Superior ore, while transportation is open costs more. The investment between the Lake Superior mines and the furnaces in the Pittsburg district, consisting of railroads, double sets of ore docks, steamships, etc., as compared with the investment between the

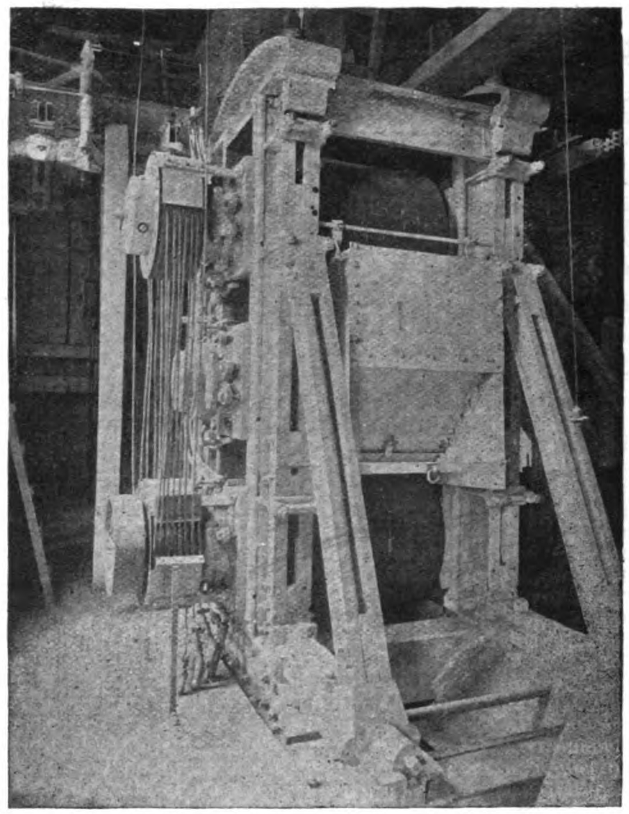


One of the Conveyors at Work.

mines at Edison and the Eastern furnaces is as 2.2 to 1.

Returning to the enterprise itself, and the view here shown of the works, we may state that the principal buildings are the power house, crushing plant, stock house No. 1, refining plant, stock house No. 2, sand house, machine shop and store room, mixer plant, briquette plant, furnace plant and stock house No. 3. Besides these there are 36 smaller buildings, including offices, blacksmith's and carpenter's shops, oil and residence buildings. The power plant includes 7 engines, of 1,800 h. p.; one compound triple expansion engine is that which ran a portion of the machinery department at the French Exposition at Paris in 1889. In the electrical equipment are 10 dynamos and 2 motors. Lighting current is generated for 40 arcs and 700 incandescents, over two and one-half miles of circuit. In the new dynamo room that Mr. Edison has taken much pleasure in laying out, is a cement switchboard, with iron frame, made on the spot, in a few days, for a few dollars. It is not so unornamental as it sounds, by any means.

Around the property are some three miles of narrow gauge railroad track, with three locomotives, the trackage varying in length and distribution with the amount of working being done on the different veins. From first to last there is an amazing absence of human labor. Mr. Edison's idea of the way to run things generally is, in its ultimate analysis, one man sitting at a little electric keyboard, while all the rest of humanity plays and has a good time. All told, including night shifts and day, there are about 250 men around the place. But for the fact that from the moment when the vein is stripped to the instant when the Edison ore briquette drops on to the outgoing car no single hand is laid on the material under treatment, there would be two or three able-bodied regiments of laborers of all styles busily engaged on the property. At the outer extremities of these railroad tracks work two huge excavators, one weighing 60 tons, the other 92, a third one being about to



Set of "Three High" Crushing Rolls, at an Intermediate Stage.

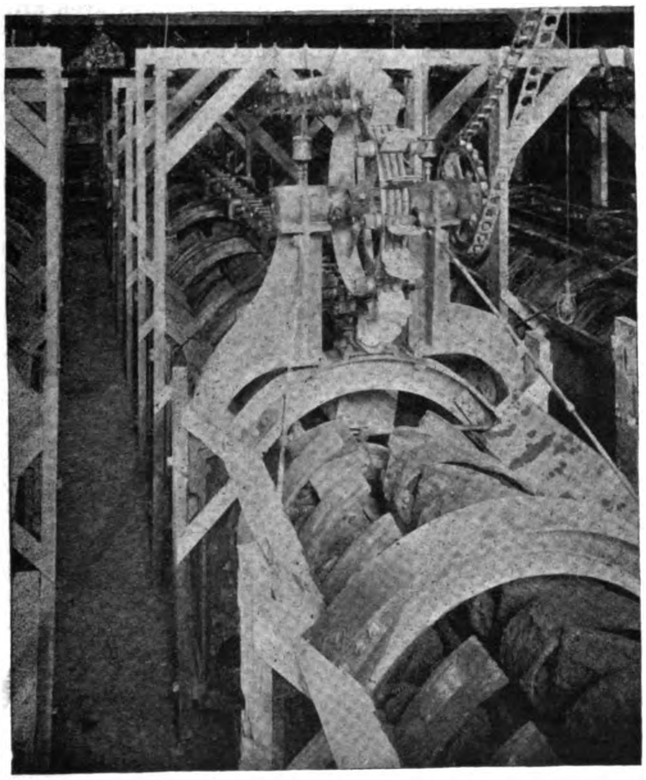
start up. Either of these will bite up four or five tons of rock every minute from the vein and keep on doing it all through the day. Dynamite is used to get the strata in an amiable and yielding mood, but Mr. Edison considers it infinitely cheaper to do the real smashing up at the breakers, so that the rock is brought away in literal boulders, a few of which would build a church. As each train of double skip cars is freighted it is hauled off to the crushing plant, where two 7-ton electric cranes, sturdy and effective, and one of them with earmarks of home production, lift it up and drop it into the jaws of the giant crushers, the skips being then lowered back to the trucks for the next trip. Four thousand tons of crude ore a day is fair working.

Our illustration shows this part of the work. The big rolls studded with knobs that are a combination of claw and fist, weigh some 130 tons, of which 70 tons is in the moving parts. They are driven by a friction belt, so lightly adjusted that in starting up from a state of rest a touch with a lever is needed for the initial impetus, when the belt and friction bring them up to full speed, with a circumferential velocity of a mile per minute. As the rock disappears between them they slow down and the friction belt again speeds them up for the next load. The faces of the rolls are 16 inches apart, so that a 15-inch

lump could go through, but nothing larger than that retains its identity. Forty cars in constant succession are needed to keep the crushers going.

The ore then goes to a pair of intermediate rolls, which are directly under the first, and of the same type, driven in the same way, except at a higher peripheral speed. These rolls are about 7½ inches apart. The ore passes to elevator No. 1 and is delivered to the top of the building. It then goes through three pairs of rolls 36 inches in diameter, and is reduced to particles of one-half inches, proceeding en route through a dryer, which gets rid of all the ice or snow or moisture, and is then taken by conveyor and elevator to stock house No. 1. The rolls are fitted with a most ingenious device, which effectively eliminates the possibility of breakage and there is no piece of crushing machinery, pair of gears, pulley or other moving mechanism in the entire plant, from one end to the other, that is not in some part of it connected up by "breaking pins." These in their respective sizes will just carry the work at full load. If anything goes wrong in the way of strains, or if nuts, bolts or any foreign substances get into the machine the pins break, and no damage is done to the machinery itself.

The idea is really a clever adaptation of the safety fuse

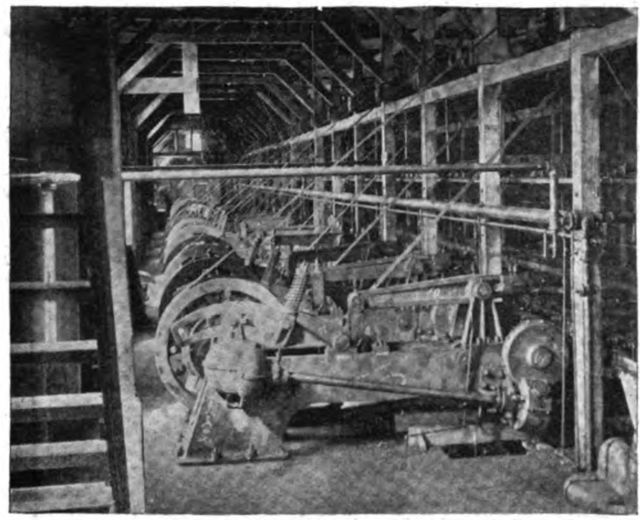


MIXERS TO WHICH THE CONCENTRATE IS DELIVERED FOR "BINDING."

principle. The pins are sized down to one thousandth of an inch. To the employment of this simple but invaluable device is owing the fact that in all the long experimental work that has been done in preparation, as well as in the actual running of the plant, the total breakage has amounted to only a few hundred dollars.

After having been delivered to the stock house the material is taken continuously, or later, by a conveyor with iron buckets, which runs at a slow speed and has a large capacity, and is delivered at the refining plant, directly over the "three-high" rolls for further reduction. When Mr. Edison first started the work he began experimenting with ordinary Cornish crushing rolls. After making several hundred experiments as to speeds, pressures and feeds of various numbers of tons per hour, he determined the fact that the friction of the machine was about 82 per cent. of the power applied, leaving only 18 per cent. for the actual work of crushing. He then set to work to improve the ordinary rolls, with the result of evolving "three high" rolls, which have more than reversed the former conditions, the friction of these machines being about 16 per cent., leaving 84 per cent. of the power applied to do the work. In the old type of Cornish roll it was found that the friction was largely due to a moving shaft running against a fixed bearing under great pressures; in the new machines it is so arranged that the bearing moves at the same rate of speed as the shaft, permitting great pressures with a minimum friction. The moving bearings are, as will be seen in the cut, made up of wire ropes.

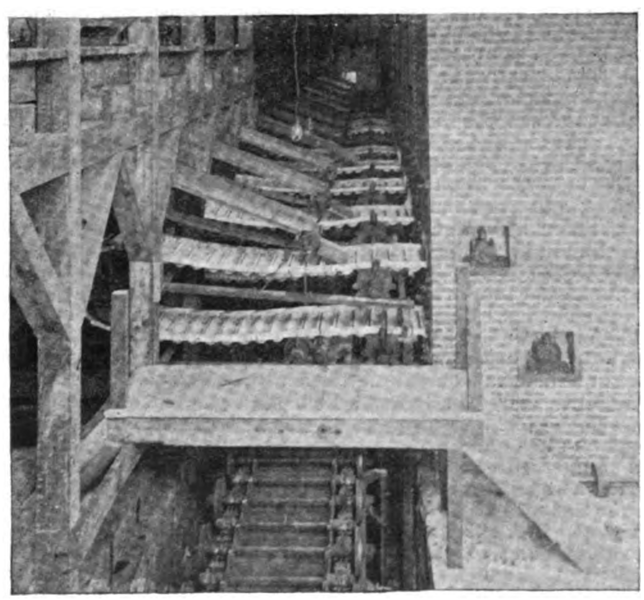
The ore is next carried to the 14-mesh screens, the portion too large to pass being returned for recrushing, while the remainder goes on to the first set of magnets. The



MOLDING MACHINES BY WHICH CONCENTRATE IS MADE INTO BRIQUETTES.

magnetic building is 95 feet high, 28 feet wide and 140 feet long, and will handle 300 tons of crushed rock per hour. The magnets have about one mile of face, and the ore is caused to fall in such wise and at such a rate before them, but not touching them, that the iron is deflected, while the gangue or tailing goes right straight down. The magnets are of special form, 6 feet long and 12 inches wide, in banks of 3 high, their power increasing from the top one to the lowest. At the start the weakest magnet at the top frees the purest particles, and the second takes care of others; but the third catches those to which rock adheres and will extract particles of which only one-eighth is iron. This batch of material goes back for another crushing, so that everything is subjected to an equality of refinement.

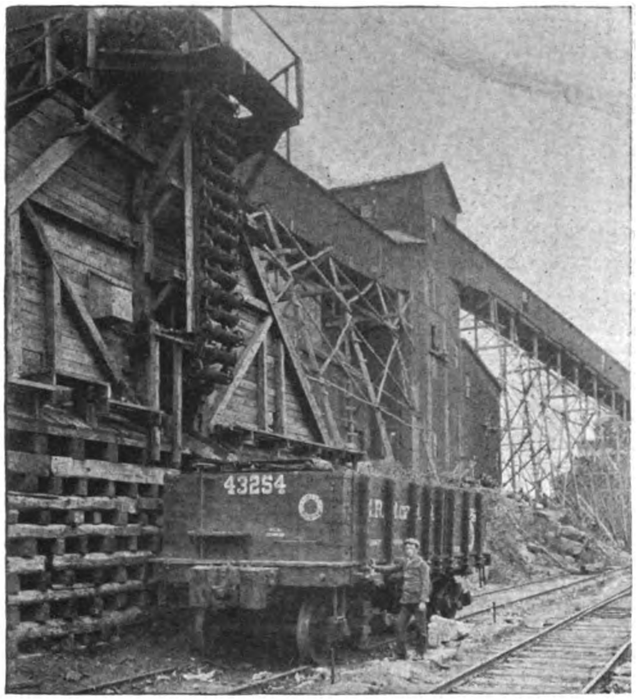
We are now in sight of the real "concentrates," which are



BRIQUETTE DRYER SHOWING BAND CONVEYORS FROM BRIQUETTING MACHINES.

conveyed to the dryer No. 2 for drying again, and are then delivered to the 50-mesh screens. Whatever is fine enough goes through to the 8-inch magnets, and the remainder goes back for recrushing. Below the 8-inch magnets the dust is blown out of the particles mechanically and they then go to the 4-inch magnets for final cleansing and separation. Current at deter-

mined voltage and amperage is delivered to the magnets from special dynamos through a special regulating and indicating switchboard. Obviously at each step the percentage of feldspar, phosphorus, etc., is less and less until in the final concentrates the percentage of oxide is from 91 to 93 per cent. As was intimated at the outset, the tailings will be 75 per cent. of the rock taken from the veins of ore, so that every four tons of crude, raw, low grade ore will have yielded, roughly,



LOADING BRIQUETTES AUTOMATICALLY FOR SHIPMENT.

one ton of high grade concentrate and three tons of sand, the latter having also its value in various ways, to be referred to later. The sand is transported, as shown, to the rear of the works and there stored in a miniature mountain, from which it can be easily loaded into cars and carried away. The concentrate in its fine, powdery state, is delivered into the stock house No. 2, holding 5,000 tons, or stock house No. 3, which has a capacity of 30,000 tons. The object of these numerous stock houses is to allow any part of the works to go on for some time despite interruption at other points; and thus, so to speak, the "load line" of output can be kept level.

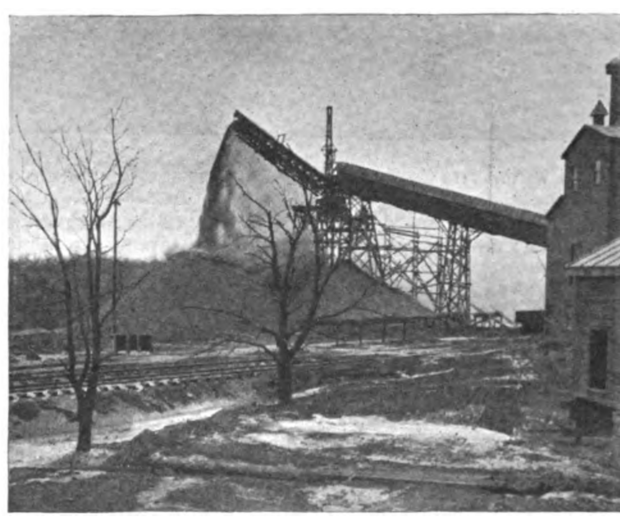
From the stock houses the concentrates are delivered to another building and into the mixers, long cylindrical machines equipped with paddles called "spreaders" and "smoothers." To the mixers a binding material of special nature is fed at one end, and after being churned up the now coherent, pasty ore is taken by conveyors to the briquetting machines in the same building, which is seen to the right of the general view of the works. At these machines shown in the illustration it is compressed into briquettes weighing a little over one pound, 1¼ inches thick by 3 inches in diameter. There are now 30 of these machines in use. In the briquetting machine the ore receives pressures running up to thousands of pounds on the whole diameter. The briquettes are then dropped by the machine on to conveyor bands which transport them to the furnaces in which they are dried. They remain in the furnace about one hour and are subjected, as they travel very slowly, to a temperature of not less than 600 deg. F. They are then carried away by the conveyor and loaded into the cars waiting on the railroad outside. The economy of labor is still so elaborated that it requires but one man to load the briquettes, distribute them in the cars and put the cars in position, the whole thing being done by machinery actuated by the pressure of two levers. The operator can load five cars without having to change his position. This work is shown in one of the illustrations herewith.

It must not be supposed that this part of the process was, at the beginning, so delightfully easy and simple as it now looks, or that the first results came up to the necessities of the case. The earlier briquettes worried Mr. Edison by the amount of moisture they absorbed. Then the concentrates did not work nicely in the furnaces, but inclined to blow out, owing to the high pressure of blast, and in other ways they interfered with the regular working of the furnaces. The difficulties to overcome were serious. Very little binding material was an essential. The first cost of such material must be very low. The briquettes must be prevented from absorbing moisture, but at the same time must be left porous to the gases in the blast furnace. Finally, the briquette must be hard at ordinary temperatures, so that it could be shipped like coal, and it must not disintegrate immediately under the fierce heat in the blast furnace. To accomplish all the above, Mr. Edison tried thousands of experiments before he found the correct binding material, but he has it. The briquette now made will absorb 26 per cent. of its own volume of alcohol, but repels water absolutely. "Weary Raggles" is utterly eclipsed.

As to results in the furnace it has been found that by the use of the briquettes the output per ton of pig iron per day can be increased from 35 to 50 per cent. over the ordinary mixtures of ores now being used, with a lesser consumption of limestone and fuel. Besides, as already pointed out, this ore has but 100 miles to travel to its destination and seems not unlikely to assume vast importance in helping to maintain the prosperity of the iron producing districts of the East, to say nothing of its effect on the export of iron now beginning to assume such large proportions.

Many features of ingenious time-saving, labor-saving, material-saving about the works could be dwelt on, for Mr. Edison, while optimistic and enthusiastic, is always keen after the shaving of each mil from the cost, and his items of expense are figured out in a way that cuts to the quick. Of new contrivances to get around difficulties and "bugs," there are any number, some relating to the dust, for it is evident that in such ore-milling works the particles fly about a little more thickly than they do in a lamp bulb. The dust was for a long time a terrible nuisance in the bearings of the elevators and conveyors, but at last Mr. Edison came to the conclusion that as it could not be got rid of he would turn the bane into an antidote. He now has a form of oil feed and bearing in which, after the oil is fed, the bearing is dusted over so as to prevent the oil running away. Dust from the surrounding air soon cakes on additionally, but as soon as the film grows too thick and heavy it is automatically flicked off, when the oil feeds again. The dust skin or shell reforms and the same cycle is repeated indefinitely. The bearings are thoroughly protected and once a month is often enough for refilling the oil cups.

A word or two must not be forgotten in regard to the sand, which meantime is piling up while the iron it was so long on terms of close intimacy with in these mountain fastnesses is gliding away to such points as the valley of the Lehigh. This manufactured sand is sharp and crystalline and, of course, remarkably even as to quality, besides being free from deleterious salts, etc. Natural sand, moreover, which has been tumbling all over itself for centuries loses its edges and is frayed and rounded. The Edison sand—like that of the "old man" himself—has not a few special high qualities



DEPOSITING THE EDISON "SAND."

entitling it to respect. It makes a splendid element in the best cement or mortar. It is just the thing for the sandbox of the trolley car or the steam locomotive, being as free to run on a damp day as on a dry, not absorbing moisture. It is already in demand also for various industrial purposes and being a by product in enormous quantities its price is very low. Nature in extracting her gold from the Californian or Alaskan rocks, by measures analogous to those Mr. Edison is using on these

low grade ores, lets her sand slip by to the sea, unregarded and lost. At this place they catch it all and will be glad to quote you on it by the thousand ton or any other quantity.

Into this vast and interesting enterprise the inventor has poured large sums of his own money, and upon the industrial and commercial results here aimed at he has been intent well nigh twenty years in thought and nearly ten in practice. Working on narrow margins of possible economy of production, Mr. Edison has proved to all associated with him that if the work be done on an adequate scale, large rewards must attend the effort. Such satisfaction none will grudge and all must wish him.

We are under many obligations to Mr. W. S. Mallory, vice-president of the New Jersey and Pennsylvania Concentrating Works, for his kindness and courtesies extended to The Electrical Engineer in connection with the preparation of this article.

AIR TALK.

BY IRVING A. TAYLOR.

If the Electrical Engineer can spare me a small corner somewhere I will interest myself, and probably someone else, by filling it up with a diagnosis of two bad cases of popular itch, of the quasi-scientific character, which are very prevalent just at present, and which will probably be dispelled by a few capsules of figures and facts. One is the vaudeville air machine itch—the adjective describes it—one of those vacuous, cigar-shaped ideas one sees the giddy ballet girl dangling her toes from, as depicted in modern theatre bills. The other is the liquefied air application itch, which, it may be remarked, is the raging desire to find a practical application for that dirt-cheap commodity—liquefied air.

In order to consider the De Bausset airship, described in the Electrical Engineer of September 16, 1897, and the appropriation for which was very righteously pigeon-holed by our United States Senate, we will suppose it to be made up of a cylinder 387 feet long, with cones at each end, each 193½ feet in length, making a total length of 774 feet. The displacement is 8,400,000 cubic feet, which, at .076 pound per cubic foot (the weight of ordinary, semi-moist air at 62° F.), and assuming a perfect vacuum to be obtained, will represent a displacement of 320 short tons weight.

The United States laws have fixed two formulas for the calculation of tubes under compression (see "The Mechanical Engineering of Power Plants," Hutton, page 690), one for tubes between 16 and 40 inches in diameter, and one for tubes over 40 inches in diameter. The first formula would give 4½ inches thickness of steel for the cylinder, and the second formula will give 36 inches. We will, however, take neither of these figures, but use the ordinary boiler formula for tension, in which the thickness of shell in inches equals the product of the diameter of the shell in inches, the air pressure per square inch and a safety factor, divided by twice the compressive strength per square inch. Taking the compressive strength at 300,000 pounds, an enormous figure only reached by tempered steel, and a safety factor as low as 3, we have a thickness of shell of .127 inch. The surface of the cylinder is 175,000 square feet, and that of each cone is 46,700 square feet, making a total of 268,400 square feet. Multiplying this by $\frac{.127}{12}$x490 (pounds per cubic foot) ÷ 2,000 we find that the shell alone would weigh 696 tons, or over twice the displacement weight.

It must be remembered that under a tensile stress the material is disposed to the best possible advantage. The actual stress in this cylinder would be both a compressive stress and more or less, probably more, of a beam action due to the tendency of the cylinder to turn, under the pressure caused by suddenly varying side winds, and the resistance to such turning which would be offered by the inertia of the mass. It will also be called to mind that on account of the large diameter of the cylinder as compared to its thickness, the principle of the arch, which would give strength to a small tube, would here be absent; and, besides the trussing which the beam action would necessitate, T shaped internal rings would have to be placed every few feet in order to stay the shell against collapse. From these considerations it would seem clear that a practical shell would weigh many times the amount which we have calculated.

Without filling the Engineer with calculations, I would say that this machine would take 5,300 h. p. to drive it at the rate of forty miles per hour relatively to the wind. The engines, boilers, gas fuel, condensers, pumps, water, etc., could, according to Mr. Hiram S. Maxim, on page 54 of the "Aeronautical Annual" for 1896, be made with a weight of 11 pounds per horse power, which gives a total weight of 29 tons, bringing this papier-mache shell and the engines needed to drive it up to 725 tons weight. What "electrical appliances" are wanted for is more than I can guess; their weight would be many times 11 pounds per horse power.

There is absolutely no future hope for displacement apparatus, and it will not pay the government, or anyone else, to encourage invention in that line. I firmly believe, however, that there is a decided future in aeroplanes, and hope to see them in extended use in my lifetime.

Regarding liquified air, I desire to relieve a misunderstanding about its cost. I think that when this is done its commercial qualities will have very rapidly depreciated in the reader's mind, and he will cast about for some less expensive material, like the gold cure, to experiment with. The yarn, if I quote it aright, goes thusly: "Five cubic meters of liquid air can be produced by Prof. Linde, of Munich, for 2¼ cents." I have not been able to find the weight of the article, but it is related to be about the same as water, so we will take it to be such, though a considerable variation from 2,200 pounds per cubic meter will hardly have a bearing on our conclusions. We have then 11,000 pounds of liquid air for 2¼ cents, or 4,900 pounds for 1 cent.

Air liquifies at 573 pounds pressure per square inch, with a temperature of—220 degs. F., that is 280 degs. F. below the usual temperature of the atmosphere, and boils with a temperature of—312 degs. F., when the artificial pressure is entirely removed. Its critical temperature, above which it cannot be liquefied even by 14,000 pounds pressure per square inch, is —220 degs. F.

The most economical cycle by which air may be liquified will be to first cool it 280 deg. F., and then compress it isothermally until it liquifies. The specific heat of air being .2375 at constant pressure, 66½ H. U. must be abstracted from each pound in order to cool it 280 deg. A refrigerating machine being the reciprocal of a heat engine, its limiting efficiency would be 521÷280=186 per cent., which means that 4,730 H. U. can theoretically be extracted per horse power hour. In practice 25 per cent. of this, or 1,182 H. U. per horse power hour, would be good work; this would serve to cool 17.8 pounds of air, or, in other words, one pound of air could be cooled by the expenditure of .0562 horse power hour. The work of isothermal compression per pound of air equals .0237 horse power, and the heat corresponding to this, and which it would be necessary to get rid of, equals 60.3 H. U., and would necessitate the expenditure of .051 horse power hour. The work of compression would probably be increased in practice from .0237 to .0316 horse power hour.

The latent heat of evaporation of liquid air I have been unable to obtain, but as it will only evaporate slowly in the open air, its value would seem to be rather large. To be on the safe side, however, we will assume it at the small figure of 150 H. U., which will take another .127 horse power hour at the refrigerating machine.

Summing up the foregoing amounts we obtain, as the total power necessary to refrigerate and compress one pound of air from the atmosphere to liquid, .2658 horse power hour. Taking the cost, including all charges on buildings, engines, compressors, refrigerators, operating, etc., of one h. p. at 1 cent, we have the cost of liquid air at .2658 cent per pound. This is on the most favorable assumptions, and does not include the cost of cold storage at 250 deg. F. for a greater or less time. This brings the cost up to $13, instead of 1 cent for every 4,900 pounds. The price per cubic meter, at this rate, is $5.83. To get down much cheaper than this means that one will either have to break up all existing thermodynamic laws or else get power at a very much lower figure.

In conclusion, there seems to be an idea abroad that, as liquified air does not rapidly evaporate, it does not rapidly receive heat. This slow evaporation is only a result of a high latent heat of vaporization, and the liquid air will receive heat as rapidly as any material at a difference of 372 deg. F. from the surrounding air, e. g., a steam pipe under 370 pounds pressure.

THE SOLENOID ELECTROMAGNET.[1]

BY H. N. WARREN.

This powerful type of electromagnet, which, after a lengthy and exhaustive research, has just been perfected at the Liverpool Research Laboratory, differs from all other magnets in the construction of the iron core; they being intended for either supporting great weights in general or the accommodation of spherical bodies, for which reception a hollow cavity is cut from each extremity, the section of each cavity representing a semicircle.

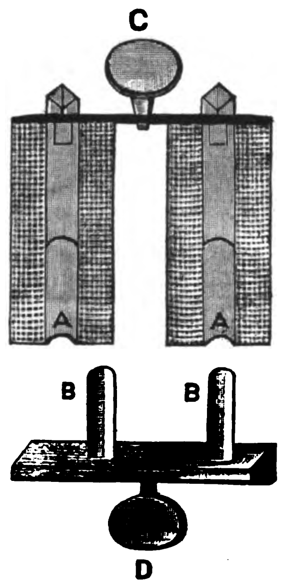
For the construction of the iron core, iron oxides, free from sulphides, silicates and carbonaceous matter, were selected, and reduced in an atmosphere of hydrogen, puddled through

[1]Chemical News.

a hot blast Siemens furnace, and drawn into bars. The bars are next embedded in quicklime, brought to a full white heat, and allowed to cool in that substance. After cooling, each limb, before yoking, is drilled to within half an inch of its circumference and one-quarter of its total length (if the bar be less than half an inch from starting, a corresponding allowance has naturally to be made).

The diagram below illustrates the section of a magnet with its accompanying keeper, the separate parts being further described in the specified table. The magnet was constructed to suspend a weight of ten tons, and required to be excited by a current obtainable from twenty-five boron carbon cells only.

From the above diagram it will be readily observed that when the keeper is applied with its two iron projections, B B, which are constructed of such dimensions as to exactly coincide with the openings, A A, not only is the magnetic



A Powerful Solenoid Magnet.

power fully utilized, but any side slipping of the keeper is absolutely impossible. All the magnets thus described were wound with No. 14 double cotton covered wire, the winding afterward being covered with paraffined insulation, wound with thread, and varnished with best electro shellac varnish. They are at present doing excellent service in researches on diamagnetism and polarization of light.

The subjoined table will better explain a few of the more important magnets thus constructed, and giving approximate quantities of their component parts:

Length and Diameter of Core.	Weight of Primary.	Voltage Required.	Weight Supported.
2 inches × ¼	4 oz.	6	8 lb.
6 " × ½	1 lb.	10	80 "
28 " × 2	9 "	50	5 cwts.
28 " × 4	100 "	50	2 tons.
36 " × 4½	112 "	50	10 "

THE MEASUREMENTS OF SMALL GASEOUS PRESSURES.[1]

BY CHARLES F. BRUSH.

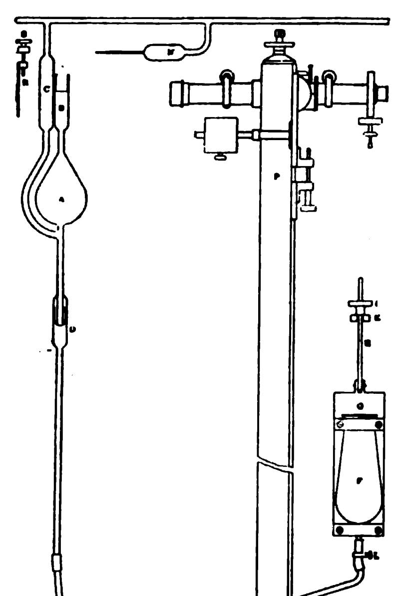
THE phenomenon which the author desired to investigate was the spontaneous evolution of gas from glass and other surfaces in high vacua. For this purpose an accurate and entirely reliable means for measuring very small pressures was necessary, because he could not afford to wait months or years for the evolution of sufficient gas to be detected with certainty by the old gauges. To meet these requirements he designed, constructed, and learned how to use, the modified form of McLeod gauge, described below.

The diagram shows the essential parts of the apparatus. The bulb A, of the gauge, is made conical in its upper part to avoid adhesion of gas bubbles when the mercury rises. This bulb holds about eleven pounds of mercury. B and C are the gauge head and comparison tube respectively. They are nearly twenty millimeters inside diameter, and are made from contiguous parts of the same carefully selected tube. D is the usual air trap and E is a long glass tube, with flexible pure rubber connections to the lower end of the gauge-stem, and the mercury cistern F. The latter is mounted on a carriage G, which moves vertically on fixed guides. The height of the carriage is adjustable; at the upper end of its range of motion, by means of the screw H, thumb-nut I, and forked support K. The screw is pivoted to the carriage, so that it may swing out of the fork when the carriage is lowered. L is a pinch-cock with screw, for regulating the flow of mercury, or stopping it. P is a cathetometer for observing the mercury columns in B and C. This beautiful instrument has a revolving column with vertical scale, and vernier with misroscope, reading to hundredths of a millimeter. The eye-piece micrometer reads directly to hundredths of a millimeter, and the divisions on the revolving head of the screw are so open that tenths of divisions are easily and certainly estimated by an experienced eye; thus permitting the micrometer to be read directly to thousandths of a millimeter. Of course the cathetometer is permanently located not as shown, but with the objective of its telescope equally distant from the axes of the tubes B and C, when it is alternately directed to them; and at such a distance that its micrometer readings correspond to a millimeter scale. The whole apparatus is located in a basement room, on a stone floor, whereby vibrations are reduced to a minimum.

The most important part of the gauge is the head B. The purpose of its great diameter is the reduction of capillary depression in its mercury column. But its size necessitates a very close approach to the mercury to its upper end, in order to sufficiently reduce its capacity. Yet the remaining space must be measurable by the cathetometer, with the utmost precision. Hence the glass must not be distorted by heating, and the closed end just over the mercury must be sharply defined. In constructing this part of the apparatus, I selected a piece of heavy tubing which would just slip inside of B, with the least possible clearance. One end of this tube was closed as squarely as possible by fusion, and then ground with fine emery and a suitable tool, to a convex spherical surface of long radius. Care was taken to make the center of curvature lie in the axis of the tube, and the ground surface was left unpolished to facilitate observation. A suitable length of the closed end of the tube was then cut off, slipped into B, and both tubes were fused together at their open ends, as shown.

For lighting the top of each mercury column, a narrow horizontal slit in an opaque screen R, is used. The slit is covered with a strip of ground glass, and obliquely illuminated by an electric lamp. The screen and slit are vertically adjusted by a thumb screw S. The heat of the lamp is prevented from reaching the mercury columns, and head B, by a thick screen. This is very necessary.

Large pressures, up to a thousand millionths or more, are readily measured with this apparatus, by finding with the



Brush's Apparatus for Measuring Small Vacuum Pressures.

cathetometer the distance between the mercury in B, and the end of the head above it; from this is quickly calculated the necessary multiplier for the number of millimeters difference in height between the columns B and C, also measured by the cathetometer, in order to express the result in millionths.

With the apparatus described, small gaseous pressures may

[1]Read before the A. A. A. S. at Detroit.

be easily measured, with a probable error of less than a thousandth part of a millionth of atmospheric pressure. The smallness of this fraction is difficult to realize. It is comparable with a thousandth part of a milligram, in a thousand grams; or a single kernel of wheat in 2,000 bushels; or an inch and a half in the circumference of the earth; or the thickness of a sheet of tissue paper in sixteen miles.

ELECTRICAL WORK IN PHILADELPHIA.

In his annual report Chief Walker, of Philadelphia, says, regarding the fire signal and telephone service:

"The importance of the extended improvement and extension of the fire signal system does not seem to be fully appreciated by the municipal legislators. There is no service under our care that should receive a more liberal appropriation each year than this system.' This city, with 129 square miles, is equipped with but 885 fire boxes, 56 of which are indoors, paid for by private individuals. New York, with thirty-one square miles, has 2,500, and Chicago between 2,500 and 3,000. To thoroughly equip the city we should have at least 2,500 signal stations. I would suggest an appropriation for the purchase and erection of 300 or more boxes and a liberal allowance each year for more. I would direct your attention to the possibilities incidental to the breaking out of a fire in any of the numerous homes, hospitals and schools, which are absolutely without communication in case of fire with the Bureaus of Fire and Police."

Continuing, he says: "The lack of appropriations for additional electric lights for 1896 prohibited the erection of any new lamps, although the demands throughout the year for locating them were repeated and incessant. The average price per lamp per night for 1895 was 41.15 cents; for 1896, 35.05 cents, and proposals for 1897 show 33.3 cents, a reduction of $42,862.25. While the number 6,228 now provided for seems to be large, yet, when the great number of streets yet to be lighted is considered, it becomes insignificant. I am now, and always have been, a firm advocate of the use of the electric light for the lighting of the highways, although I have always differed with the companies with reference to the amount charged for the light. I have always contended for a lower rate, a conclusion to which the companies have arrived, as shown by the yearly reduction in their proposals. The price named for 1897 begins to have a more reasonable aspect.

"During the year there have been laid 221,834 feet of conduit by the city, and, through the facilities offered by the rental of ducts in these conduits, the Western Union and Postal Telegraph Companies have been enabled to place the great bulk of their circuits below the surface of the streets, and have removed many of their poles and overhead wires.

"Within the city limits there are 51,200 poles (wood and iron) and 6,163 miles of wire overhead. The city has removed 96 poles and taken down 67 miles of wire. The Postal Telegraph Company has removed 261 poles and 146 miles of wire, the Western Union 17 miles of wire, the Brush Electric Light Company 2 wires and 8 poles; 517,624 messages were transmitted by the police telegraph system and 32,318 by the telephone switchboard; 764 alarms were transmitted over the wires of the fire alarm system."

PHYSIOLOGICAL EFFECTS OF ELECTRIC CURRENTS.

Some interesting observations concerning the physiological effects of electric currents have been made by M. Dubois. He finds that the effect depends much more upon voltage than upon intensity. With the same voltage, for instance, a fall of the resistance from 270.000 to 72,000 has no effect, at least as far as the minimum of perception is concerned. But a profound effect is produced by the insertion of external resistances, owing to their self-induction. Even the most non-inductive resistances have a marked effect. The inductance of the human body is practically zero, and hence the great difference produced by the slightest internal inductance. But the effect of an external resistance may be compensated by inserting a capacity in the circuit. In one case quoted a capacity of 0.0045 microfarad reestablished the physiological effect which had been cancelled by the insertion of a resistance of 600 ohms.

RUMORS are afloat all over the electrical trade that some fifteen or sixteen of the insulated wire and cable companies are getting together and will "pool their issues," operating only certain selected factories. The business has long been run on much too small a margin.

MR. W. F. HANKS, of The Electrical Engineer staff, was one of those fortunate enough to escape unhurt from the mysterious accident on the New York Central on Saturday night last, when some twenty persons were killed or drowned. He was able to render material aid in the work of rescue. One of those whom he helped was Mr. Long, of the Perkins Company. It was at first rumored that Dr. Habirshaw and Elmer Morris were in the wreck, but, like many others from the street railway convention, they had fortunately taken other trains.

MR. RICHARD LAMB read a paper on Wednesday evening on "The Development of Electric Cableways" before the American Institute of Electrical Engineers in this city.

ELECTRIC LIGHTING

METERS VERSUS FLAT RATES.

BY. R. F. SCHUCHARDT.

THAT the existence of flat rates for current is a bar to the proper growth of an electric plant is recognized by all central station men who have changed from flat rates to meters. Competent authorities claim that the meter saves nearly 30 per cent. in the output of the plant, that being about the amount wasted by the average consumer under the contract system. This saving, secured without reduction in the revenue per lamps wired, is further increased by the longer life of the lamps when burned less and the consequent fewer renewals. As the amount of light used by a consumer depends entirely upon himself, he can regulate his bill and there will be fair dealing on both sides. Another advantage of meters lies in the detection of bad leaks outside of the station. The existence of such leaks can be determined by comparing the summation of the consumers' readings with the reading of the switchboard meter, allowance being made for the loss in the line.

In spite of these advantages and ultimate saving a great many central stations, especially among the smaller cities, are crawling along with the contract system, content to let well enough alone and satisfied if their income is sufficient to pay the actual running expenses and leave a small profit. Ask the manager of any such station what his daily output is or how much coal, oil, waste, etc., the plant uses per day and he will be unable to tell you.

Many of these stations have started as arc light plants where the current was shut off at the switchboard at the stipulated time. Incandescent generators were added in recent years and the current was charged for in the same manner as for arc lights—so much per month. Most of these generators are run during the daytime for power and fan motors, consequently the lights that are never turned out—and there will always be some that are not—burn twenty-three hours per day, the plant shutting down during the noon hour for repairs, cleaning up, etc. Where a time limit, such as four hours per night is specified in the contract, and the charge made per lamp hour the condition is somewhat improved, but even in this case, the waste is, as stated before, about 30 per cent.

The writer knows of a city where a flat rate of 50 cents per month per 16 c. p. lamp exists, with no agreement as to the number of hours the lamp is to burn. As a result there are many consumers (in basement stores and the like) who never take the trouble to turn out the lights, and many who let them burn, at least all night. The same evil exists with the fan motors, which you can hear buzzing in the downtown stores at all times, even on the coolest days. The plant supplies current to a considerable number of power motors, for which a charge of $5 per horse power per month is made. This horse power is determined from the rated capacity of the motors or from the amount calculated by the user as necessary to run his machinery. The actual number of watt hours supplied is what should be paid for, and how can this be determined without a meter when the load is as varying as it is in factories.

The somewhat weak argument of the owner, who is also manager of the plant, is that no one will use electric light if a time stipulation is made and that none will buy his current by meter. The reason for this is very obvious from the following:

A meter was installed in a saloon where the lights were burned all night. In three months the amount registered was 1,310,000 watt hours, or, at 10 cents per k. w. hour, a bill of $131. The owner of the saloon had the meter taken out immediately, claiming it must be wrong. He paid $36, his old contract agreement, for those 1,310,000 watt hours. Is it surprising, then, that the consumers will insist on flat rates, knowing that they can have them? The case of this city is cited to show how flat rates generally work, for there are many like it.

How can a manager ever hope to make his plant a good investment for the owners when he is so blind to their interests that he sees this go on daily without making an effort to

change the conditions? But how could he, one may ask, bring about a change after the people have been educated to this kind of business and still keep his customers, especially if a gas company in town is fighting him at every turn.

First of all, if this owner has other interests to look after, as is the case in many of the smaller towns, he should not try to run the whole thing himself, but should employ an electrical man to look after electrical matters; one who will have a daily record kept on proper forms of the station "input" and "output" and from that determine a schedule of rates which will permit of a fair return on the investment. By getting rid of all "cheap" labor he can reduce the station expenses to a minimum. The small leaks, in and out of a station, which continually occur with incompetent help often determine the turning point between failure and success.

Then, in the spring, at the approach of the long days, he should begin to install his meters. Make them 10 per cent. slow for the heavy consumers, if necessary, for a start. Have him give the best of service and back it up with up-to-date energy so he will get enough good customers to enable him to drop the "kicking robbers" whose lamp renewals and current cost as much as they are paying under the flat rate. But will even these customers, once having known the convenience and excellence of the electric light, want to change back to matches and the oxygen consuming gas unless the cost of electricity is exorbitant?

The spirit of equity ought to pervade all his dealings for the friction between the public and the management, which always does exist to a greater or less extent, must be kept at a minimum, especially if the company has the municipal lighting contract and must therefore keep the good will of every voter.

Finally, the writer would urge the central stations still using flat rates to abandon a system so unjust both to themselves and their customers, and to sell their current according to the only equitable method—by meter.

G. E. ENCLOSED ALTERNATING ARC LAMP.

THE new alternating current arc lamp, manufactured by the General Electric Company, illustrated herewith, operates on constant potential alternating circuits with high economy and greatly diminished noise. The principles of the enclosed arc lamp and the economical advantages of its use over open arc lamps are familiar to our readers, but as between open and enclosed alternating arc lamps, it is not so generally known that a greater difference in economy in favor of the enclosed lamp is shown than in the same comparison between open and enclosed direct current arc lamps. In the G. E.

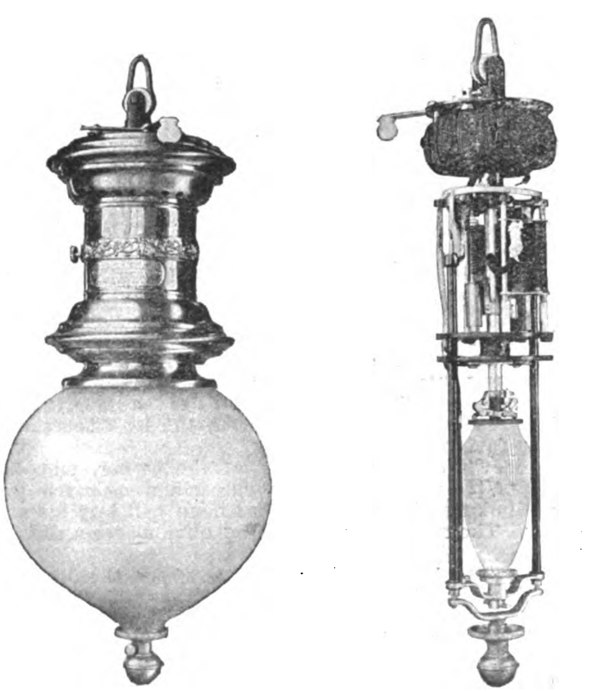


Fig. 1 and 2.—New G. E. Alternating Enclosed Arc Lamp.

alternating enclosed arc lamp one pair of carbons will last between 60 and 70 hours, and induce a saving of about 80 per cent. in the cost of lamp carbons; a larger arc is maintained; the light is emitted without obstruction, and its protection from currents of air and any sudden action of the mechanism allows the light to become and remain steady.

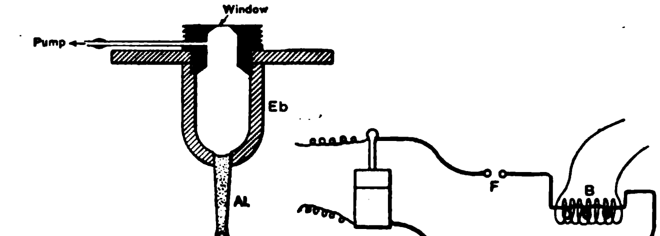
The mechanism is simple, the number of moving parts being reduced to a minimum, and its action is quick and positive. A special adjusting spring keeps the current constant whatever the position of the core. The mechanism is supported on a frame with a double base, which gives a dead air space and provides protection for the mechanism from the heat of the arc.

This lamp operates on circuits of 100 to 120 volts and 60 or 125 cycles frequency. About 70 volts are required at the terminals of the arc, the normal current being 5.5 to 6 amperes. An inductive resistance contained within the ornamental top of the lamp, and connected in series with the arc, gives the necessary reduction in the voltage, and preventing sudden changes in current, minimizes unsteadiness of the light. The half-inch carbons used are 9½ inches long in the upper holder and 6 inches in the lower—one cored, the other solid, and they must, of course, be of high grade. They are proportioned to allow the piece left in the upper holder after one run to be used in the lower holder for the next. The inner globe is supported by a self-locking device. To lower the globe the lower ball is unscrewed, the globe raised slightly and released by turning the release screws on the side of the cylinder. To replace it, the globe is simply raised until it locks, when it is tightened by screwing up the lower ball.

The General Electric alternating current enclosed arc lamp is 28¼ inches in length and 31⅛ pounds in weight. It is artistic in its proportions and is judiciously ornamented. For interior illumination, i. e., for halls, large stores, restaurants, theatres, public buildings, the casing of the lamp is finished in ground brass or black enamel. For outside use a weather-proof casing is furnished.

SIMPLE APPARATUS FOR GENERATING LENARD RAYS.

T. Des Coudres, in Wiedemann's Annalen, describes a novel apparatus for generating Lenard rays without Lenard's experimental skill which should make these precursors of X-rays accessible to the rank and file. The generating tubes are not of the short-lived glass type, but are made of ebonite (see diagram), and are about the size of a finger. They have an ebonite flange to prevent external discharge, and a brass screw cap for an anode, which also contains the aluminum window and the tube leading to the pump. The screw cap also has an out-



Novel X-Ray Bulb.

side thread to which any "observing space" may be screwed and fixed with marine glue. The cathode rays are less subject to absorption if the increase of potential at the electrodes is very sudden. Electric oscillations of great amplitude and high frequency may be obtained by the arrangement shown in the second diagram. The primary circuit of a large inductor consists of a Leyden jar and a copper band, B, passing in three turns round an ebonite tube 10 cm. long. A zinc spark gap is inserted at F. The secondary circuit consists of 60 turns of thin copper wire. By this apparatus the author succeeded in proving that cathode rays behave outside the generating tube in exactly the same manner as inside. They have the same coloring effects upon salts. Impinging upon a platinum or other surface, they generate Röntgen rays, and they also impart a discharging power to gases traversed by them, probably to some extent by their own direct action.

AN X-RAY PHOTOMETER.

To facilitate the study of X-rays, A. Imbert and H. Bertin-Sans had a special kind of "photometer" constructed by M. M. Ducretet and Lejeune, which consists essentially of a fluorescent screen over which is laid a coarse grating of lead wires and a prism of aluminum. When the X-rays examined are feeble, they are only able to penetrate the thin end of the prism, and no shadows of lead wires are visible on the screen except under the thin end. This happens when the vacuum tube is exhausted just sufficiently to give X-rays. As exhaustion proceeds more lead wires become visible, and when the tube is on the point of becoming non-conducting the illumination over the whole of the screen is uniform, and the shadows stand out with equal sharpness. At this stage, indeed, aluminum becomes perfectly transparent to the rays, and so do the bones of the hand. This type of rays is particularly well suited for the radiography of the deeper-seated anatomy.

BEHAVIOR OF RAREFIED MEDIA UNDER ELECTRICAL DISCHARGES.

The results of a preliminary study of the conditions which exist in highly rarefied media under discharges of electricity are described by Prof. John Trowbridge in a paper entitled, "The Energy Conditions Necessary to Produce the Röntgen Rays," read before the American Academy of Sciences.

It appears from the experiments "that the discharge in a Crookes' tube, when on the point of emitting the Röntgen rays most intensely, is an oscillatory one, and that each discharge encounters a resistance less than five ohms. An estimate of the great amount of energy thus developed in an exceedingly small interval of time can be obtained if we suppose that Ohm's law holds for individual oscillations. This reservation is an important one, for the investigations I have described in this paper show that a discharge of six inches in length encounters no more resistance during its oscillations than one of two inches in length. In popular language, it can be maintained that a discharge of lightning a mile long encounters no more resistance than one of a foot in length. Ohm's law does not hold good for electrical discharges in air and rarefied gases. It is well known that a voltaic arc can be started in a vacuum. My experiments lead me to believe that in every case the arc is started by a spark which breaks down the medium, and the arc follows. I am led to believe that electrical oscillataions are of the nature of voltaic arcs, and that the discharges in Crookes' tubes are voltaic arcs. I am thus forced to the conclusion that under high electrical stress the ether breaks down and becomes a good conductor."

LITERATURE

STANDARD ELECTRICAL DICTIONARY—Second Edition, Revised and Enlarged. By T. O'Conner Sloane, New York, Norman W. Henley & Co., 1897. 682 p.p.; 5x7 in. 393 Illustrations. Cloth. Price, $3.

This excellent work has undergone a thorough revision and we note a number of corrections of errors which were made in the first edition, and the rewriting of a definition here and there where such was necessary. The new part, which the progress of the art has largely made necessary, has about 400 words, including synonyms, and has its own index at the end of the volume. The synonyms which are given are a very useful addition to this work, and the index also is quite an innovation, which, in a work of this character, has its distinct uses. With the added part, bringing the work up to date, the volume will prove of much value in the hands of all electrical readers and students, as well as to the lay reader.

ALUMINUM.—Edited by Alfred E. Hunt. The Pittsburg Reduction Co., Pittsburg, Pa. 266 p.p.; 4½x7 in. Cloth. Price, $1.50.

Aluminum, once a curiosity in the arts, has now become a factor, and a very important one at that. To know its properties fully is a necessity to engineers in almost every branch of work, and the electrician, especially, now frequently finds it to be a valuable material at his hands. In the work before us Capt. Hunt has gathered together a most complete digest of all the known facts in regard to this most valuable metal, and added thereto a great deal of the experience gained by the Pittsburg Reduction Company in its manufacture and use. We find not only valuable tables of the physical properties of aluminum, but also information on the use of the metal for structural purposes, as an alloy with other materials, together with complete tables of weights of the metal in sheets, bars, etc. Also the electrical resistances of pure aluminum wire from No. 000 to No. 40 B. & S. gauge—in short, everything that is thus far known of aluminum in its application in the arts. Added to the information on aluminum itself is a most excellent series of tables of gauges, weights and measures, and a variety of other information in daily use by electrical engineers. We can recommend the book highly for the evident care with which it has been prepared. It constitutes, indeed, a standard work of reference on aluminum.

THE ENTROPY-TEMPERATURE ANALYSIS OF STEAM ENGINE EFFICIENCIES—With Blank Diagram Arranged for Easy Application to Any Concrete Case. By S. A. Reeve, M. E. New York. Progressive Age Publishing Co., 1897. 20 p.p.; 6x9 in. Flexible Cover.

The application of the entropy method to the analysis of the operations going on in steam engine cylinders has but a comparatively recent origin, but the facts which this method of analysis bring out are so well defined and graphically shown that it is getting to be a favorite method among intelligent engineers. The obstacles which have stood in the way of its general utilization by steam engineers appear to be due to its apparently involved nature. In reality, however, the method is quite simple, when thoroughly understood, while the results attained are greatly superior to those obtained by means of the usual discussion of the steam engine diagram alone. To facilitate the application of the entropy method to the analysis of steam engine efficiencies, the author has, in the present little volume, prepared a very concise practical essay on the subject. This is accompanied by a blank diagram arranged for easy application to any concrete case. We can highly recommend the work to all engineers desirous of learning more about the actual work performed in the steam engine, whether they be designers or users.

VOCABULAIRE TECHNIQUE FRANCAIS-ALLEMAND ET ALLEMAND-FRANCAIS.—Second Edition, Revised and Enlarged. By Prof. Dr. F. J. Wershoven. Leipzig, F. A. Brockhaus, 1897. 234 p.p.; 4½x6½ in. Paper. Price, $1.

This little work is gotten up on a very excellent plan. Instead of stringing along terms alphabetically in the usual way, without regard to the subjects to which they refer they are grouped alphabetically under a series of sub-titles, each devoted to a particular line of scientific or industrial work. Thus there are sub-heads under physics, mechanics, chemistry, metallurgy, engines, railways, etc., and each of these sub-heads in turn is subdivided into groups. Thus, under physics and mechanics we find the group of electricity, with no less than ten subdivisions, relating to condensers, dynamos, the current, electrolysis, central stations, electric light, motors, etc. The plan of the work is not merely to translate individual words, but in the majority of cases to give the phrases most current in the works related to the subject.

For those who are obliged to consult foreign works the little book will prove of exceeding value.

LETTERS TO THE EDITOR

ISOLATED PLANTS IN JAPAN.

Referring to the article entitled, "An Interesting Isolated Plant at Yokohama, Japan," by Lamar Lyndon in your issue of Aug. 26, I regret that I must appropriate from Mr. Lyndon any glory that there may be in having installed the first private plant for lighting tea firing "godowns."

In the latter part of 1889, when I was one of Messrs. Frazer & Co.'s electrical experts, they installed in the godowns of Messrs. Hunt & Co., a 25-light plant, consisting of a small Edison bipolar generator driven from the shafting of the factory. This plant was used considerably during my residence in Yokohama previous to the building of the Yokohama electric light station. ARTHUR CHURCHILL, M. A. I. E. E.

London, Eng.

BROOKLYN BRIDGE—The trolley roads, working together, expect to make 3,000 car trips daily over the Bridge, a carrying capacity of say 150,000. The cars will run four per minute in the rush hours.

THE
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ELECTRICITY ON STEAM ROADS.

We have had in the past not a few papers in which the authors have discussed the question of the application of electricity to the operation of trunk line railroads, and many of these have contained valuable data. Though for the most part based on fair assumptions, they have, on the other hand, to some extent been speculative. But all these writings lacked that essential quality that leads the skeptic to conviction, and that is actual facts and figures based on experience. This, of course, was no fault of the authors above referred to, who in many cases have brought to bear exceedingly able arguments and experience in steam and electric street railway work; but we are glad to note that at last we have been put in possession of some data upon which a fairly good estimate can be based of the practicability and probable cost of operation of trunk line electric service. This data is embodied in the extremely interesting and valuable paper read by Col. Heft last week before the American Street Railway Association at Niagara Falls. In this paper Col. Heft gives, in condensed form, the experience obtained on two branch lines of the N. Y., N. H. & H. R. R. system. The branches present examples of the two methods of construction, namely, the overhead conductor and the third rail system, and therefore afford valuable data for comparison. The results obtained point unmistakably to the practical superiority of the third-rail system as the method to be employed for this class of work, and are a strong confirmation of the opinions of many who have carefully considered the problem. As Col. Heft shows, at the high speed at which the Nantasket road is operated, disturbances are apt to arise in connection with the trolley, which the third rail obviates entirely, while, on the other hand, the difficulties anticipated with the third rail are much less serious than was anticipated. As regards the danger from personal contact it is shown to be a small factor, and thus far no loss of life has been recorded, although not a few persons have come in contact with the rail and received shocks, even under circumstances most favorable to produce injury. Even this small amount of danger, we think, could be readily obviated by a system of construction which would make it practically impossible to come in personal contact with the live third rail, except intentionally. Such a construction need not necessarily involve great expense, while if the right of way were protected against intrusion occurrences of such a nature would be entirely shut out.

No doubt the question of leakage of current from the third rail in wet weather with submerged tracks is one that the managers of the road which Col. Heft describes viewed with pardonable misgiving, but the results of actual practice are reassuring in the highest degree. To have a track two inches under water without being able to discern an increase of current on the line, is certainly a remarkable manifestation, taking into consideration the potential employed. It has long been known that leakage between conductors submerged in ordinary rain water is not nearly as great as it is generally assumed to be, and, indeed, we may here recall some experiments made by Mr. Edison some years ago at Orange, N. J., with a low potential railway system, in which both conductors were submerged for several hundred feet. The voltage at that time, if we remember rightly, was about fifteen volts, and the results showed an insignificant amount of leakage. That the same would have been shown with a potential as high as that employed on the Hartford & New Britain Road, we must confess, is somewhat of a surprise. To be sure, the length of section submerged was not very great, but, nevertheless, the results are a good indication of the fact that even under extraordinary conditions an interruption of traffic due to a submerged rail is not to be feared with the third-rail system.

Another practical point alluded to is the operation of the motors under the cars. Col. Heft believes that the ironclad motor is deficient in regard to ventilation, and in this he is supported by Prof. Short, whose admirable comments of Col. Heft's paper will be found on another page. Prof. Short goes so far even as to say that an increase of 20 per cent. in output could be obtained, if the motors were freely ventilated and divorced from their ironclad shield. We recall numerous instances in the early days of electric street railroading when motors were unprotected and passed safely through some pretty ugly track conditions, in which mud and water were the principal features. The art of motor insulation has not stood still since that time, and hence it seems not unreasonable to believe that the ironclad method is not so absolutely essential as it may appear to be. As Prof. Short points out, it will probably be desirable and necessary to thoroughly protect the commutator, but the thorough enclosing of the other parts of the motor might be done away with, at least to the extent of providing better ventilation than is possible with the present type of motors.

These are only a few of the practical points touched upon by Col. Heft, but they ought to be sufficient to set railroad men to thinking. When it comes to the actual figures of cost of operation and other details of traffic, no railroad man, we are certain, can view the results recorded without an instinctive feeling that we are on the eve of a change in railway motive power, which no amount of conservatism can hold back much longer. The cost of operation given by Col. Heft shows at what low figures traffic can be maintained, even making all due allowance for low cost of the fuel employed in this instance, namely, locomotive sparks. It is probable that this type of fuel may have a not unimportant influence on the future of electric railroad work as applied to the present steam roads. Through their medium, perhaps, shorter branches may be equipped by the trunk lines, and it will probably then be only a question of time when contiguous main line stretches will be converted from steam to electricity. As the "sparks" give out with the withdrawal of steam locomotives, the usual coal will take its place, from sheer force of necessity. But

traffic managers on steam roads will probably "lick their chops" when they learn of the enormous increase of traffic engendered by the introduction of electric cars; 400 per cent. increase in one year is enough to make any railroad man dizzy with the possibilities which lie before him, and when one analyzes the reason for this increase it is plain enough. Open cars, no dust, cinders or soot, and plenty of air, are sufficient inducements to travel, while with all these comforts the speed is as great as, if not greater, than with the steam locomotive. We might go on enumerating other points in Col. Heft's paper, but enough has been said, we believe, to impress upon all railroad managers the necessity of studying the situation and taking leaves from the book of experience of the N. Y., N. H. & H. Railroad.

HIGH-HANDED TREATMENT OF A LOCAL COMPANY.

WHILE it was known that the Terre Haute Electric Railway Company had been undergoing a severe strain upon its resources due to the burdens put upon it lately by local feuds, it was hardly expected that the vigorous and gallant efforts of President Russell B. Harrison would not pull it through successfully. Much to the surprise of the electrical public the course of events has compelled a receivership and the history of the case is so interesting that we are glad to be able to give details which we believe to be wholly accurate and fair in their setting forth.

The Indiana Legislature last winter passed an act authorizing the city of Terre Haute to extend the company's heavy street paving assessments or indebtedness into a longer time, lower rate interest bond. The council last June unanimously passed an ordinance granting the extension and bond issue. The mayor, who is reported to be opposed to the company, announced that he would refuse to sign the bonds, and when asked the reason stated that in his opinion the act was unconstitutional. During the months that have passed since the enactment of this ordinance the company have been submitting legal opinions to him of the best lawyers of the city and State, as to the city not being responsible for the bonds and the constitutionality of the act. These opinions included that of Ex-United States Attorney General Miller. But the mayor would not accept them, and, it is said, urged the city treasurer to the precipitate and before daylight levy at an hour when the company could not get funds in bank, or friends to its assistance. Then the mayor made an affidavit as to the indebtedness and placed the company in the hands of a receiver until all questions can be determined. A part of the indebtedness for which the company is sued for a receiver is owned by the company, and part of it is not due, but had the mayor signed the bonds there would have been no taxes standing against the company. The action of the mayor was not authorized by the city council and was unknown to them. Moreover, he has no authority in the matter of collection of taxes under the laws of the State, but used the police force to prevent the operation of the cars.

The sentiment of the community is overwhelmingly against the action, as shown by the comments of the local press. The company has paid already this year $5,000 into the city treasury on account of street paving assessments, and was given no notice that a levy was intended. The city council, believing that a serious blunder has been made, and to show their feeling, unanimously adopted a resolution last week, complimenting and requesting the receiver to retain the present management. It is stated that there has never been a case before in Indiana where a receivership was applied for in a tax matter, and those well informed do not think that such a step can be taken in the matter of street paving and assessments under any condition.

Where an enterprise is so necessary to the public comfort and welfare as a street railway is it seems to us that measures the very contrary to those to which we have called attention should be adopted by the municipal authorities. Unfortunately more than one case is on record of useful public enterprises being broken down in this way under the impulse of personal hostility or other malicious antagonism; and while we disclaim any intention of expressing opinions adverse to anyone to whom the sudden move against the company was due, our sympathies go out very warmly to Mr. Harrison, whose company we hope soon to see free and prosperous. There are other street railway companies upon whom these exacting requirements of paving, etc., press very heavily, and just to that extent they are hindered in efforts to give the public the best service possible.

POPE PROGRESSIVENESS.—GEAR vs. SPROCKET.

THE recent announcement that the 1898 Columbia wheel of the Pope Manufacturing Co. will have a chainless bevel gear is of interest to hundreds of thousands of lovers of outdoor exercise and sport. But it seems to us to be worthy of more than passing comment, especially among electric railway engineers, as it is a reminder of a very important chapter in their own experience. Van Depoele, it may be recalled, ran his first electric street car by means of a sprocket and chain gear, the motor being fixed on the front platform of the car. Troubles developed, however, and the sprocket and chain were finally abandoned for the double reduction gear, and the latter, in turn, again, for the single reduction, which has maintained its place, and bids fair to do so for some time to come. We believe that there are some, though few in number, who still believe in the efficacy of the chain gear for electric cars, but their voices have long since been silenced amidst the general acclamation in favor of the toothed gear. We imagine that the bevel-geared bicycle will enjoy much the same experience. When once its merits have been demonstrated the chain will have to go, just as it did in the case of the car. One cannot but admire the courage and foresight of Col. Albert Pope, in deciding to make so radical a change in bicycle gear, but we understand that the commercial step was not taken without a thorough and prolonged trial of the bevel gear, so that the innovation is less of an experiment than might appear at first sight. Many street railway men will watch the new bicycle gear with more than usual interest, for they cannot fail to be struck with the parallelism thus signalized between two great branches of modern means of transportation.

CARBON DUTIES.

WITH regard to the recent controversy as to the manner in which the new duty should be levied on imported carbons, it is stated that Assistant Secretary Howell has instructed customs officials that in the opinion of the Treasury Department the duty of 90 cents a hundred on electric light carbons should be based upon the length of the carbons as used in the lights. In order to avoid paying this rate of duty importers had the carbons shipped to them in pieces of sufficient length to make three for commercial use, and insisted that the long pieces should be admitted at the rate fixed by the tariff law. The question was presented to the department a few weeks ago by Appraiser Wakeman, of New York. It will be seen that this decision, while expected, does not go to the real merits of the case, as all carbons are lumped together by it in one category. There is still room for improvement in the wording of the law or its interpretation.

125 PATENTS ISSUED TO MILO G. KELLOGG.

AMERICAN inventors have eclipsed all others in prolificness and the number of patents issued to individuals, but all records have been broken this week by Mr. Milo G. Kellogg, of the Kellogg Switchboard and Supply Co., Chicago, to whom no fewer than 125 patents were issued on Tuesday, embodying over 2,000 claims on multiple switchboards for telephone exchanges. The patents are assigned to the Kellogg Company. This is the largest number of patents ever issued simultaneously to one inventor, and the final Patent Office fee of $2,500 was the largest single payment ever received at the Patent Office.

ELECTRIC TRANSPORTATION

ELECTRICTY ON STEAM SUBURBAN RAILROADS.

BY PROF. S. H. SHORT.

IN response to your request, it gives me pleasure to review briefly some of the, to me, most interesting and important features of the paper read before the Am. St. Ry. Assn. by Col. N. H. Heft, of the N. Y., N. H. & H. Ry. Co., giving valuable results obtained by his company in the application of electricity as a motive power for heavy suburban traffic. The enormous increase in passenger traffic upon the Nantasket Beach line and the New Britain line since the installation of the electrical equipment is a most convincing argument in favor of the electrical equipment of the suburban trains on steam railways. The first year of the electrical operation of the Nantasket Beach line showed the marvelous increase of nearly 93 per cent. over the steam traffic. During the last year it has amounted to three times that of the last year with steam power. On the New Britain line the increase has been 400 per cent. over the corresponding months of last year.

These results are undoubtedly due to the frequent train service. the freedom from smoke and cinders, the low fare and the high rates of speed. Col. Heft points out the impossibility of operating trains and maintaining schedules by steam locomotives, in the way now being done by electricity, upon their lines. The acceleration curves show that the trains attained a speed of 38 miles an hour in a little over a minute and in a distance of 2,400 feet; which could be materially improved upon by the use of larger motors. Only 400 amperes of current are consumed by the motor car in acceleration, while double that quantity can readily be used by a single truck equipment on a double truck car, such as is used by the N. Y. & N. H. road, without going beyond the safe tractive limits. On these lines, as on elevated railways, the rapid acceleration of trains is the all-important factor in reducing schedule time.

The use of open cars in summer, made possible on steam railways only where the electric motor is used, withdraws a great deal of traffic from the competing steam railway lines, and foreshadows a revolution in the construction of passenger cars for suburban service on steam railways. Some interesting suggestions are made with reference to the use of open motors for this class of work, to insure perfect ventilation. This is undoubtedly the right direction in which to work. By properly designing a motor to readily shed water, and by water-proofing both armature and field coils, the complete casing could be dispensed with, as the only part of the machine absolutely requiring a cover is the commutator. By leaving the motor entirely open to the free circulation of air it would do fully 20 per cent. more work for the same rise of temperature.

I am somewhat surprised to learn that there is so little leakage from the third rail when there is no other insulation provided save creosoted wooden blocks between it and the ties. To be sure, when it is perfectly dry no leakage would occur, but Col. Heft states that even when the rail is covered with water during heavy rain storms, there is no apparent leakage indicated at the station. I imagine, however, that with a network of radiating lines, including many miles of track, all fed from the same station, leakage might become quite serious under some conditions, unless some better means of insulation were provided.

Excellent provision has been made by the New Haven road for distributing their electric power through exceedingly low resistance circuits. The third rail is heavy—100 pounds to the yard—well bonded at the joints with flat copper plates whose conductivity is greater than that of the rail itself. These plates are rivetted to the steel rail in such a way that the conductivity of the joint is in no way impaired by time, and the experiments which have been made from time to time to determine the resistance of these joints shows that they have not depreciated in conductivity. The service rails are double bonded and are not connected to the ground. No feeder system is used so far, but, of course, when the traffic becomes greater it will be necessary to use some method of feed service. I would suggest the use of alternating current transmission at high pressure and rotary transformers at intervals, feeding the third rail. Apparently no difficulty has been experienced with 600 volts on the third rail, and the other terminal of the generator, but two feet away on either side. Men seem to work on the track without difficulty, except in wet weather, when, it is claimed, the third rail is "lively." I believe, however, that eventually the third rail will be more or less protected.

I think that one of the most beautiful illustrations I have ever met with of the economy of electric traction, as compared with steam locomotives, is given in Col. Heft's paper. All of their electric power stations, including the Nantasket Beach, the Berlin, and a number of street railway stations owned by their company, are to-day being operated exclusively by the "sparks," or unconsumed fuel taken from the extension fronts of their locomotives. These sparks, which are caught after passing through the flues of the locomotive boiler, are only a portion of the unburned fuel which the locomotives are constantly wasting—a large portion being always thrown off from the stack. The exceedingly low figure of about .2 of a cent per horse-power hour is obtained by the use of these "sparks" as fuel, where they are charged to the power stations at the rate of 70 cents per ton, showing them to be almost as good fuel as the slack soft coals which we find so abundantly at about a dollar a ton throughout the greater part of the United States.

It has been with a feeling of personal gratification and satisfaction that I have followed this practical attack upon the greatest problem now before our railroads by Col. N. H. Heft and his associates of the New York, New Haven & Hartford Railway Co. Their intelligent struggles upon such a large scale have been rewarded with corresponding large and successful results, and other roads can now take up the work where these patient pioneers have disclosed it, adapting it to their individual peculiarities, but always sure that with equal persistence and thoroughness they will reap the same rich reward in economy and efficiency of service.

POWER DISTRIBUTION AND THE USE OF MULTIPHASE CURRENT TRANSMISSION FOR ORDINARY STREET RAILWAYS.—II.

BY MAURICE HOOPES.

FOR temporary uses, it is possible to make the necessary switchboard connections with flexible cables as the only adjuncts to the apparatus on the regulation board. A cable which may be attached to the positive lead of any of the generators, at the switchboard, and to any feeder, answers the entire purpose. With some boards, it is only necessary to have terminals on the cable that may be inserted into switch jaws.

At best, however, cables are troublesome appliances and

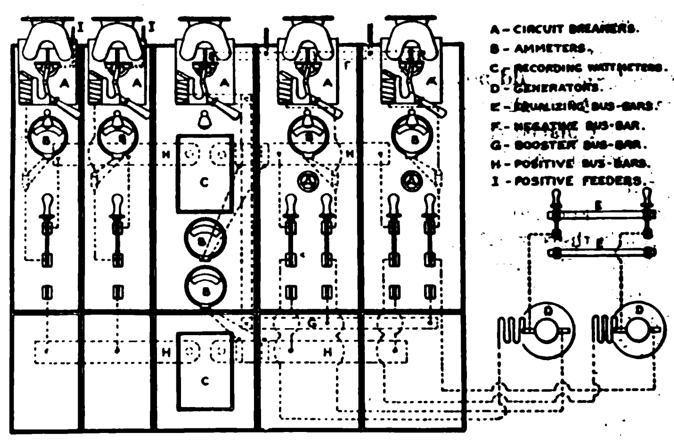


FIG. 1.

allow only comparatively slow transfers. Moreover, it is impracticable to arrange cables so that two generators may be run in parallel on the special high voltage service. Where a new board is being installed, and where the circumstances justify the alterations in an existing board, such a one as is shown in Fig. 1 meets the required conditions. The two equalizing bars make it possible to run two or more machines on each, the regular and high voltage at one time. With this arrangement any two combinations of feeders and generators desired may be had. When running the "special generator" the negative switches are thrown up, and the positive and equalizing switches on the special machines thrown down. The switches on the feeders needing the increased voltage are likewise thrown down. If it is desired to use the auxiliary bus for booster purposes, the equalizing switch is left open and the adjustable field shunt applied, the negative generator

switch is thrown down, after closing the booster circuit breaker, and the feeder is transferred down to the auxiliary bus. This puts the booster generator in series with the particular feeder. One very important thing in this connection is to make sure that the shunt field circuit is open on the boosting generator. It might be advisable to interlock the field switch with the negative generator switch in such a way that the latter could not be thrown down except with the former open. The drawing of the board shows a wattmeter and an ammeter in each bar. By providing a double throw switch connected in such a way as to open the lower wattmeter from the feeder board, and connecting it to the uuper bus bar on the generator side of the ammeter shunt, the four instruments will be in series between the generators, all running on the lower bus, and the feeders all running on the upper bus. This offers convenient means for checking meters, care being taken to see that current passing through the diagonal bar on the back of the instrument panel does not introduce an error into the wattmeter indications.

In a modern station of few large units it is improbable,

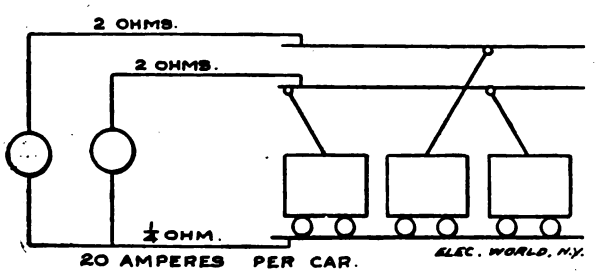
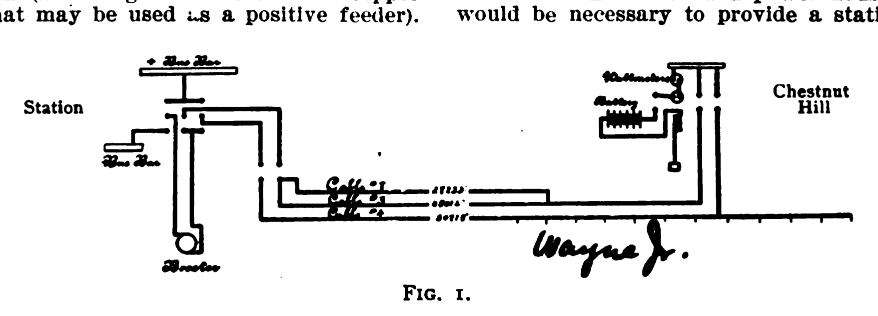


FIG. 2.

were the necessity for booster service to exist, that one of the large generators could be spared or would be desirable for the purpose. In such stations, however, it is usual to install a smaller machine to carry the all night and other light loads. This machine might be relied upon for the booster work. If the engine driving it has its governor arranged to adjust for a large variety of speeds, both above and below normal, and the unit be designed to run safely at the increased speeds, the combination will be found very convenient for meeting all classes of demand.

The "three-wire system," although very useful in lighting work, has been of little service in railroad distribution. Its value for the latter purpose has been considerably overestimated, although there are places where its use has resulted in the maintenance of satisfactory potential on sections of track, using the same copper, when the usual system could not approach doing it. The advantage of the three-wire system is based on the fact that it enables the use of double the usual potential for distribution, thus in the perfect case requiring but one-fourth the copper to transmit a given current at a given loss.

The writer has said that the value of the three-wire system in railroad service has been considerably overestimated. This statement probably needs explanation. In lighting work the three-wire system saves 62½ per cent. of the copper. Because this is true of lighting work, it is often assumed to be true of railway work. It is not, however, and in no case where the track renders any appreciable service as a conductor, can the saving from the adoption of the three-wire system approach the above figures. In general, its use will make a gross saving of the loss in track (assuming that there is no copper paralleling the track that may be used as a positive feeder).



Wayne Jr.

FIG. 1.

The net saving will be this gross loss in track less the track losses due to the passage of current from car to car, and of the excess of current due to lack of balance, back to the power station, and the increased overhead loss due to the greater drops in the divided feeders than in them when combined. The sketch (Fig. 2) may present this more intelligibly. It illustrates the simple case of an unbalanced three-wire system, and shows that its losses aggregate 4,100 watts under the particular load. If this system were changed to a two-wire one by throwing the two feeders in parallel, it would save 400 watts in the feeders, and lose 800 more in the track, leaving a net loss of 400 watts, or about 10 per cent. of the total loss. Such a difference as is shown by this hypothetical case would not justify the complication introduced by the system. The only conditions where the method seems to be applicable are those of excessive track losses with fair opportunities for balanced load. Such a case existed on the Lowell & Suburban Road. They have a heavy business over a double track line to their park, some six miles from the power station. By changing to positive feeders those formerly used as overhead returns, and operating the line as a three-wire one, they very greatly improved the efficiency of the distribution system.

APPLICATION OF THE STORAGE BATTERY TO ELECTRIC TRACTION.—II.

BY CHARLES HEWITT.

THE APPLICATION OF STORAGE BATTERIES ON THE ENDS OF LONG LINES.

In such applications the conditions are entirely different. The battery in this case acts essentially as a pressure regulator. The conditions do not restrict the size of the plates, so that the plates can admit of such a size that the current density on discharge can be kept well within the limits of normal discharge; and in consequence of this the battery is not subject to the great loss of efficiency, due to the fall of e. m. f. on discharge. Only a few such installations have been made, two of which are on tne Isle of Man; one has been installed by the Anaconda Mining Company at Butte, Mont.; there is also a small plant at Merrill, Wis. The first installation, however, that has been made for any large city road for its suburban service, I find, is the one installed by the Union Traction Company, of Philadelphia, Pa. The road was originally a horse car line, which ran as far as the depot at Pelham, a distance of 7.3 miles from the power house. Conduits and cables were installed for operating a number of cars which were supposed to be amply sufficient. The phenomenal increase in the travel, however, necessitated a large increase in the car service. In addition, the success of the line warranted its extension to Chestnut Hill, 2.3 miles further. More recently the line has been extended to the Wheel Pump on the Bethlehem Pike, making the line 11.2 miles from the power house. The investment in feeders for this line had reached a point considerably above $100,000, not including the conduits. To have increased the cable system so as to have supplied this section properly would have required about 336,000 feet of 1,000,000 c. m. cable. At $1.05 per foot laid this would amount to $352,800; deducting the value of cables which were already laid, and which are estimated at $79,000, we find that the extra cost for cables without conduits would have been $273,800; this figure is, of course, prohibitive.

In order that you may appreciate the condition of the line previous to the installation of the battery I would call your attention to the fact that 350 volts were frequently touched. The average was a little over 400 volts, with 530 at bus bar. It was necessary, therefore, to furnish some means of keeping up the pressure. If a station had been built at that point it would of necessity have been small and inefficient. From records taken at the main power house, it was found that it would be necessary to provide a station of about 750 k. w. capacity; such a station would have cost about $85 per horse power, or a total of $85,000. A battery station on the other hand required but little real estate, and would be inexpensive to operate, and its costs would be considerably less than a power station. In the Chestnut Hill plant the entire cost of real estate, battery and building was approximately $25,000; to this must be added the cost of a booster in the main power

house. This required a 200 k. w. generator, which, with its engines, would cost about $8,000. The total cost of battery and booster would, therefore, have been $33,000. In this installation, however, they simply adapted a 300 k. w. generator at their power house to this service, so that they were put to but little extra expense in the power house for adapting it to booster purposes. We find, therefore, that deducting $33,000, the cost of the battery and booster, from $85,000, the cost of a station, that the difference in first cost is $52,000, in favor of the battery. In addition to this, they were put to an expense of a little over $13,000 for changes in the cable. In the estimates that follow I do not include any cost or interest on the cable, as the investment would have been about the same, whether they had built a station or installed a battery. It is very apparent, therefore, from the facts given, that on the score of the first cost, the battery was by far the cheapest installment which they could make. In order that you may better understand the results which I propose to give in reference to the operation of this battery, I beg to describe the plant somewhat more in detail.

You will see by Fig. 1 there are three cables concerned in this work, which are numbered No. 3, No. 4 and No. 7, all of 1,000,000 c. m. capacity; the lengths of these cables are shown on the diagram. Cable No. 4 is the only one which supplies the trolley wire direct, or, in other words, all the tops from the underground cable to the trolley wire are tapped on cable No. 4; this cable runs all the way from the bus bar at the power house to the end of the line on the Reading Pike at Chestnut Hill. It feeds in all about twelve miles of trolley wire. Cable No. 3 runs direct from the power house to the bus bar at the battery house, as shown in the diagram. Cable No. 7 simply augments the capacity of cable No. 3. In ordinary operation the current on cable No. 3 passes through the booster at the power house, by which the initial pressure is raised 150 volts, more or less, above the ordinary bus bar pressure of 550 volts. By this means the drop in the cable is overcome, so that the pressure at the battery house can be adjusted to a point where the battery varies but little to either side of the zero point, or in other words, it charges and discharges continually, and consequently maintaining a constant e. m. f. where the current passes out from the battery house through cable No. 4, as shown in Fig. 1. This cable (No. 4) is therefore fed from two points, namely, from the power house end at 550 volts and from the Chestnut Hill end at about 515 volts. As a consequence the distribution along the line from Wayne Junction to the end at Chestnut Hill is comparatively uniform and is now very satisfactory.

At first the battery was allowed to discharge during the day about three times as much as it charged, making up the charges continually, maintaining the load on cable No. 3 nearly constant, and consequently maintaining a constant charge at night between the hours of 1 a. m. to 5 a. m. Later the amount of day discharge was decreased until the charge and discharge were about equal. The first gave a very even voltage of a little over 500. With the present method the voltage is somewhat more irregular, but the average is somewhat higher. By keeping the battery continually up to full charge, the night man has been dispensed with. The paper was accompanied by a chart showing the regularity of potential maintained.

When the load in the line is low, the current going over the cable No. 3 to the battery house, divides at the bus bar, one part supplying the necessities of the line, the other part charging the battery. When the demand on the line is heavy, the pressure drops a little at the battery house; all the current going over cable No. 3 will pass out over cable No. 4, and in addition the battery will discharge sufficiently to make up for the extra demand for current. This has the effect, as I have stated above, of keeping an almost constant load on cable No. 3. At times the load on cable No. 3 has become so heavy as to exceed the cable's capacity. At such times by an arrangement of switches at the power house, shown in Fig. 1, cable No. 4 is put on the booster as well as cable No. 3. In doing this, the current through the booster is largely increased, but the pressure can be reduced from about 250 to 125 or 130 volts, and, in addition, better pressure is obtained at the Wayne Junction end of the section.

COST OF OPERATING.

From our experience in operating power houses of various capacities we find that a power house operated at Chestnut Hill under conditions which I have described would cost about 1½ cents per kilowatt hour.

The author then gives detailed figures showing the comparative cost of operating with a power house and the battery station. These show that the saving in cost of installing battery over a new power station at Chestnut Hill is $52,000 and the saving in operation $1,350 per month, or $16,200 per annum; the latter figure including all allowances for interest, depreciation, labor, taxes, etc. The total watt hours delivered at the battery house for May, 1897, was 103,053,448, and the amount delivered to the feeders at the power house 130,710,380 watt hours. The highest charge per 24 hours for the same month was 300,000 watt hours, and the average 218,380 watt hours. The average efficiency was 90.8 per cent. At no time was the battery more than half discharged. At the end of fifteen months of continuous operations we have only had to repair two leaky tanks at an expense of about $25. The positive plates look as good as when first installed, and show no depreciation whatever; the negatives, on the other hand, have contracted somewhat and some of the plugs have cracked, but this in no way impairs their usefulness. This method of power distribution cannot be considered economical per se, but where the conditions are such as we have described there is no question as to the economy in favor of the battery.

APPLICATION OF BATTERY TO POWER HOUSE.

This form of installation has not become very generally appreciated in this country, and but few installations have been made. As its advantages become better known, I feel confident the practice will become more general. The wide fluctuations in load in railway power houses are now well known. The average daily load varies from 50 per cent. of the maximum in small stations to 70 per cent. of the maximum in the largest stations. From a very large number of observations in all parts of the country I find that in the majority of stations the average load is very close to two-thirds of the maximum load. Now, it is also a well known fact that the maximum economy of the steam engine exists for a very small range of load, and that on each side of the point of maximum economy the efficiency falls off; rapidly on the overload, somewhat less rapidly on the underload. The result is apparent. In most stations the engines, at the best, have an average load of only two-thirds their most efficient load, and as a consequence consume over 4.5 pounds of coal per kilowatt hour. With badly regulated engines, and especially with water power plants, the changes in load are accompanied by variations in speed and consequently in voltage. These troubles may be entirely corrected by installing a battery.

The battery in this case becomes distinctly a load regulator.

MUNICIPAL OWNERSHIP AND OPERATION OF STREET RAILWAYS.—II.

BY P. F. SULLIVAN.

DIFFERENCE IN CONDITION.

IN a previous paragraph, I showed the difference between St. Louis and Glasgow. Below will be found a comparison of other cities of nearly the same population, taken from the "Yale Review" for May, 1897:

	Population.	Area in sq. miles.	Street railway mileage.	Mileage per sq. mile of area.	Mileage per 1,000 of population.
Birmingham ...	497,000	20	33	.066	1.65
Boston	494,000	37	295	.597	8.00
Edinburg	289,000	14	21	.072	1.50
Detroit	300,000	28	202	.673	7.21
Leeds	400,000	34	27	.067	0.79
Cleveland	350,000	32	205	.585	6.40
Liverpool	641,000	21	66	.103	3.14
St. Louis	644,000	62	216	.300	3.50
Manchester ...	530,000	20	54	.102	2.70
Baltimore	512,000	34	262	.511	7.70
Bradford	228,000	17	21	.091	1.23
New Orleans ..	250,000	40	169	.676	4.22
London	4,400,000	105	230	.052	2.19
New York	1,851,000	59	357	.203	6.05

Compare any one of the above foreign cities with an American city of the same population and you will find that the area of the latter is greater and the street railway accommodations greater in proportion than the former. The English cities average over 15,000 persons, and the American cities over 2,600 per mile of track. And yet there are those who would state that because Leeds could operate 27 miles of track successfully that Cleveland, with nearly the same population and area, could also operate 205 miles of track, nearly nine times as many miles of track, also successfully. If, therefore, the methods of civil service and administration were the same in both cities, Leeds could be eminently successful and Cleveland a monumental failure.

COMPARISON OF ADMINISTRATION.

(From "City Government in the United States," by Alfred R. Conkling.)

"The Right Honorable Joseph Chamberlain, in an article on 'Municipal Institutions in America and England,' in the 'Forum' for November, 1892, makes an interesting comparison between Birmingham (his residence) and Boston. He says the total annual municipal expenditure (excepting the appropriation for schools and alms houses) of Birmingham is but $1,665,000, while that of Boston is $10,194,000, or more than six times greater than the expenditures of Birmingham. The two cities have much in common. They have about the same population and are both large manufacturing towns.

"The public works of American cities are perhaps the field of more swindling than any other department of the municipality. Brooklyn furnished us with an object lesson. For example, the Commissioner of city works found nearly fifty sinecures in his department, and he has begun by abolishing these offices, at a saving of $50,000 a year to the city. The result is that he has that additional sum to expend upon actual work for the welfare of the public. Fifty other idlers in his department are marked for early discharge and the Commissioner of Public Parks has also dismissed seventy-five men whose only occupation was drawing a salary!"

"The comparative cost of municipal government in Europe and America is easy to understand. Any person who inspects the annual budget of the chief cities of the Old and the New World will be startled at the economy of the one and the extravagance of the other."

Financial statement of representative cities:

	Population.	Fiscal Year.	Net Indebtedness.	Capita Indebtedness.	Annual Interest Payment.	Annual Expenditure.	Cost of Education per Capita.	Annual Expenditure per Capita.
London	4,221,452	'90-91	$225,000,000	$53.29	$10,801,675	$54,601,965	1.58	$12.93
Glasgow	782,728	'93-94	39,620,770	50.61	1,321,890	9,046,000	1.62	11.54
Birmingham ..	429,906	'92-93	38,146,440	88.73	1,335,125	7,330,025	1.45	16.36
Berlin	1,579,244	'92-93	68,275,000	43.23	2,450,000	29,915,950	2.16	18.31
New York	1,515,301	'94	101,428,481	66.93	4,889,383	37,362,065	3.04	24.65
Chicago	1,438,010	'94	17,722,950	12.32	851,421	32,020,184	4.24	22.26
Boston	494,205	'95	37,131,423	75.13	2,443,716	22,099,543	5.09	44.71

The average per capita expenditure of the foreign cities above mentioned was $14.79; of the American cities $30.84.

"The new mayor of Chicago (1894) has said that the greatest danger of cities is that of being robbed by their own officials, in the sense of being burdened with expensive and superfluous office holders. In one month he directed the city treasurer to reduce his salary 10 per cent. and transfer it to the general fund.

"A law was passed in 1883 to build a new acqueduct from the Croton River watershed to the City of New York. This stupendous public work became a harvest for politicians; large sums of money have been squandered upon it, and much of the work had to be done over. The defective work, was in part, owing to corrupt inspectors and engineers, who approved work that was not only contrary to specifications, but done in a most scandalous manner.

"The public works of American cities are, perhaps, the field of more swindling than any other department of the municipality. Mr. White in his suggestive article in the 'Forum' for December, 1890, says: 'The city halls are the acknowledged centers of the vilest corruption.' In that connection this remark applied chiefly to the aldermen, and occasionally to the mayor. But the public works that are controlled by the officials in the city halls of the larger towns are generally as badly and corruptly done as the proceedings of the city legislature. I could give many examples, but I shall simply remind the reader of the 'Tweed' courthouse in the City of New York, which cost untold millions, and the new city hall of Philadelphia. The visitor to the Quaker City is at once struck with the prominence of this public building. The gigantic tower is a monument to the extravagance and corruption that formerly existed in the city government.

"Unfortunately, the inspectors of public works in large cities are often political appointees 'out of a job.' They must be taken care of by the ring, and are put upon the pay rolls to the detriment of the citizens. Their salaries are so low, and their 'assessments' or contributions to the ring so large, that they are often forced to approve of defective public work, or blackmail the contractors of private dwellings in order to support themselves and their families. These inspectors learn from their superiors lessons in the practice of blackmail. Their political employer or overseer has probably extorted money from the contractors on public and private buildings, so that he is not surprised when his clerks and underlings in turn pursue the same practice. These inspectors show discretion in levying tribute on citizens."

DISCIPLINE OF EMPLOYES.[1]

BY GEORGE H. DAVIS.

A ROAD has good discipline when all employes respect and kindly regard each other; when the officers do their best for the men, and vice versa; and when both officers and men sacrifice everything to the interests of the company. Discipline should never be interrupted in the narrow sense that a man is to work as a machine. There are, however, certain principles which are probably of universal application. First of all, a railway manager must gain the implicit confidence of his officers and men. To do this he must, in general, know the details of the design, construction, operation and maintenance of railways. He must have a universal reputation among his men of being shrewd, vigilant, industrious, honest and perfectly fair in his dealings. He must know them all personally, stand by them and respect them as gentlemen upon all occasions. He must be thoroughly popular and able to create among them a spirit of loyalty and enthusiasm in regard to the road and its interests. A thing of greatest assistance in discipline is complete organization. Every man engaged in railway operation, from president to track greaser, should have before him in printed form a full synopsis outlining all the essential features, the exact limit, scope and character of service that he is to render. All officers should have their exact relative rank in the service, which should be thoroughly known among all employés. In this way if conflicting oral orders are given, the order given by the officer of superior rank will be obeyed without question.

It is important in railway operation to issue all orders in printed form, clearly and definitely stated. These orders should be sent in explanatory personal letters to all superintendents, foremen, inspectors and starters, and be published on conspicuous bulletin boards at all stations. An order should never be issued except that it meets with the approval of the best officers and men, and after once issued, it should be an infallible law, applicable to all employés alike, and if broken, it should in all cases be followed by a prompt, severe penalty. Satisfactory discipline cannot be maintained unless employés in all ranks are worked to their full natural capacity and physical strength.

Written reports for the smallest details of both good and bad features of the service should be insisted upon from all officers of the company, and a false report or statement from any employé should be sufficient cause for his instant discharge. Nothing good or bad in a man's service should be passed without the manager's recognition. One of the strongest incentives to good work among men who are trying to do their best is praise.

As a partial solution of the different questions arising in connection with discipline, a competitive civil service system is offered as a suggestion.

Any successful competitive civil service system for railways must take into account: 1. The previous history of the applicant, including his railway experience. 2. His knowledge and skill in railway operation, which is covered by competitive examination. 3. His physical condition. 4. The quality of his work after entering the service.

In all departments of the Canal & Claiborne Railroad Company employés are placed upon a basis of competition. Men are employed who have the best standing according to a

[1]Read before the American Street Railway Association at Niagara Falls. Abstract.

broad competitive examination, and are placed in the lowest rank of any given branch of the service. Promotions in the various branches, so far as practicable, are made consecutively from one rank to another. The company fills every position from among its own employés, provided there is anyone in the service competent to take the place. To illustrate, if the position of chief dispatcher were vacant, all starters employed by the company would be eligible to compete for the position. The chief dispatcher prepares all schedules, knows the exact position of every car on the road and the crew that is operating it. Now, if, upon competitive examination, it was found that no starter employed by the company was able to prepare a thoroughly practical, satisfactory and economical schedule, then no one in the direct line of promotion would be given the position. In this case another examination would be held, in which the employés of all departments would be eligible, together with the employés of other companies or outside persons. In this way, merit alone is recognized as a basis for advancement, and also the highest standard of efficiency is maintained in the various positions. So far as practicable, the same regulations apply to the transportation department, the maintenance department and the accounting department. In the transportation department, in the employment of motormen and conductors, when an applicant presents himself, if he is worthy of consideration after a preliminary conversation and inspection, he is given application and recommendation blanks. To be eligible to appointment as motorman or conductor the applicant must be between the ages of 25 and 40; for the position of motorman he must weigh at least 160 pounds and not exceed 210 pounds, and must be at least 5 feet 8 inches in height; he must have had at least one year's experience in the position he seeks, and should be recommended to the service by at least three officers of the company, including foremen, inspectors and starters, and also by at least seven motormen and conductors who are already in the service. He then obtains the company's physician's certificate with regard to his physical condition. If his certificate, application and recommendations fill the requirements and are apparently satisfactory, they are then given to an inspector, who personally investigates his previous record among the employés with whom he has worked, and also among outside persons who know the applicant. If the inspector's report of investigation is satisfactory, the applicant is placed on the lines of the company with motormen and conductors who have the best standing in the service. He rides with these men until he is familiar with the special features of the lines of the company. He is then given the competitive examination. This is intended to be extremely practical, and consists of two parts: First. The applicant takes charge of a car with an inspector, who estimates the quality of his work for one trip over each line of the road. Second. He answers a list of questions covering the various things connected with this department of railway service. Finally, the applicant presents himself at the office of the general manager, where he is questioned in regard to all orders and instructions previously issued by the company, and his understanding of the conditions under which he will be expected to work.

THE APPLICATION OF ELECTRICITY TO RAILROADS NOW OPERATED BY STEAM POWER.[1]—I.

BY COL. N. H. HEFT.

THE New York, New Haven & Hartford Railroad Company owns and controls about 2,800 miles of main line railroad track in New York, Massachusetts, Rhode Island and Connecticut, of which about 16 miles are operated by electricity on the third-rail system and 14 miles on the overhead trolley system.

The company also owns the entire capital stock of the Stamford Street Railroad Company and the Meriden Electric Railroad Company, the former operating about 10½ miles of track and the latter about 17½ miles on the overhead electric system.

About three years ago the New Haven Company found that various electric railways in its territory were gradually extending their operations into the field of interurban work, and that the company's passenger earnings were suffering accordingly. It was at once seen that, by no ordinary method of changing schedules or increasing speeds could this lost traffic be won back again, and, with characteristic knowledge and courage, President Clark and the New Haven directors determined to "steal the thunder" of its new competitors, and commenced a series of elaborate experiments in heavy electric railroading.

The author referred to the two lines constructed by the company, namely, the Nantasket Beach, with overhead, and the Hartford & New Britain branch with third rail. These have been fully described in The Electrical Engineer.

TRAIN SERVICE AND TRAFFIC.

On its Nantasket Beach line the New Haven Company gave, during the last summer, a regular half-hour service from 6:30 in the morning until 11:30 at night. On Sundays and holidays, when boats arrived at Pemberton every fifteen minutes during the greater part of the day, express trains between Pemberton and Nantasket were sandwiched in between accommodation trains in such a way as to give a fifteen-minute schedule of alternate express and accommodation trains. The time-table this summer required thirty-three regular trains daily, each way, between East Weymouth and Pemberton. During July and August the traffic increased to such an extent as to require six motor cars in constant week-day service, and on Sundays and holidays eleven motor cars have frequently been called for.

The fares charged on the Nantasket Beach line before the advent of electricity were 10 cents from Pemberton to Nantasket and 18 cents from Nantasket to East Weymouth, a total of 28 cents from Pemberton to East Weymouth. With electric traction they have been placed at a uniform rate of 5 cents from Pemberton to Nantasket and 5 cents from Nantasket to East Weymouth, a total of 10 cents from Pemberton to East Weymouth. Under these new conditions the traffic has increased enormously on this line; the summer of 1895, the first of electrical operation, showing an increase of 92.5 per cent. over the previous summer in the number of passengers carried; the summer of 1896 showing 54.1 per cent. increase over 1895, while in the summer just passed we have carried nearly three times as many passengers as in the last year of steam operation.

The operation of the line from New Britain to Hartford was commenced in May last, with a regular half-hour train schedule from 6 in the morning to 11:30 at night, and with a uniform fare of 10 cents each way, instead of 23 cents, the former charge. The electric line carries through passengers only between Hartford and New Britain, the passengers for the five way stations being carried by the regular steam trains running on a parallel track. For ordinary, every-day service, a single open motor car was used during the past summer, while for extra loads light double truck trail cars, seating seventy people were attached. On rainy days a standard closed passenger coach was hauled by the open motor car. On holidays and Sundays the cars pulled two trailers, the entire train seating nearly 250 passengers. About the middle of August steam service on the Berlin-New Britain branch was discontinued, and traffic has since been handled entirely by electricity. Sixteen trains each way per day are run, connecting with steam trains.

Under the conditions named on the Hartford-New Britain line we have carried, during the three summer months, 400 per cent. more passengers than we carried through the corresponding months of last year.

SPEED, ACCELERATION AND SCHEDULES.

I do not suppose that any but a trained railroad man can understand the impossibility of operating trains and maintaining schedules by steam locomotives in the way that has been done by electricity at Nantasket Beach this summer. There are no excessively sharp curves or steep grades, and it is not here that the trouble has come. The difficulty is found in the fact that there are no less than 17 stations on a line only 16.6 miles in length, or an average distance between stations of but about .6 of a mile. To make a run of 10 miles with 15 stops in 26 minutes; to be obliged to do this in order to connect with boats arriving at regular half-hour intervals and to keep out of the way of frequent regular steam trains on the main line of the Plymouth division; to allow but 4 minutes at each end for unloading, switching (including running around trail car), and loading; and to do this day in and day out, in regular service, through an entire summer; these are things which cannot possibly be accomplished by steam locomotives.

Now, the reason why electricity can do this and steam cannot, is found in the tremendous accelerating power of properly designed electric motors, with rotary motion, as compared with reciprocal motion of steam locomotives. By examination of the curve of acceleration plotted from actual tests of a 60-ton train, and of the practical results shown in the curve of speed between stations in a service run on the Nantasket Beach line, as well as the time chart made up from the company's printed time cards, one can observe how enormous is this accelerative power.

For example, a 60-ton train, in running from Windermere to Allerton, a distance of only 1,800 feet, reaches a maximum speed of 31 miles per hour, while in the longer run from power station to Nantasket Junction, a distance still of but 5,808 feet,

[1]Read before the American Street Railway Association at Niagara Falls. Abstract.

a maximum speed of 39 miles is reached. The entire distance is covered, in regular service, at an average speed of 24.6 miles per hour, including stops.

Between Hartford and New Britain, the 9.3 miles distance is covered regularly by motor cars with two trailers in from 18 to 20 minutes, an average speed of from 28 to 30 miles per hour, while, with a special high-geared motor, a maximum speed of over 60 miles has been made, the entire distance of 9.3 miles being covered in 10 minutes. On this line a 52-ton train often reaches a maximum speed of 50 miles per hour. The current is cut off at twenty-nine grade crossings when single car trains are run.

It is worthy of note in this connection, that the line between New Britain and Hartford is in direct competition with a trolley line between the same points, but following a more circuitous route. The schedule time of trolley cars is 55 minutes, as against our time of less than 20 minutes, and the rate of fare is 15 cents (including a transfer given for use on the street railways of either city)), as against ours of 10 cents for the straight run between the two cities only. The ownership of right of way has a very important influence upon speed and competitive conditions under circumstances like these.

CARS AND EQUIPMENT.

The type of car selected for any good transportation service has a direct bearing upon the development of traffic and maximum gross receipts. It has been difficult for steam railroads to depart from the long-established custom of closed passenger coaches of the present standard type, and to adopt open cars, on account of the disagreeable effect on passengers of the smoke and gases from engines. This has naturally thrown a great deal of traffic to competing street railway lines running open cars in summer, on account of the much greater pleasure in riding.

With electric operation, open cars in heavy railroad practice are possible, even at considerable speed, particularly if the front of the car is closed in with glass, and both at Nantasket Beach and on the Hartford-Berlin line we have used heavy open cars with great success.

The motor car which we have so far used we do not consider, by any means, the final type, and even now we have in mind plans of combination cars which, we believe, will be, on the whole, well adapted for railroad work. The present motor car is very heavily built, with floors of a height equal to that of our standard passenger coaches. It contains 16 cross seats, capable of seating 96 passengers, and the entrance is from either side with three steps. Each car has two heavy railroad trucks, one of which is equipped with two 125 h. p. motors. The total weight of the motor car is 32 tons, and the trailer car of the same type weighs 25 tons. The motors which we have used up to date have been of a type common in heavy elevated railway work. These motors have often been in service for several consecutive days, making 324 miles each day, without apparent injury. We found the motors we are using already in the market when we commenced our experiments, and until recently no attempt has been made by us to specify changes. Under these circumstances, great credit is due the manufacturers for their efforts to meet the difficulties encountered. The experience gained with these motors has served as a basis for building larger and heavier types, better adapted for the severe work which they will be called upon to fulfil to meet our requirements. An important point which we shall specify in new motors is that they shall have the most perfect ventilation possible. The efforts of manufacturers have been hitherto directed toward completely encasing the motors, so as to make them waterproof, but in doing this, ventilation has been sacrificed. We have found it beneficial to blow out our motors several times during the day by means of a blast of air from a hose pipe connected to our air-brake reservoir, but this is, at best, but a make-shift.

For future work we are making an effort to simplify the mass of cables and other equipment mechanism by putting some of it, particularly the wires and cables, in a space between the true floor of the car and a false floor several inches below, specially provided for the purpose.

For operating heavy trains of this character, where currents of from 500 to 1,000 amperes are sometimes used, the controlling apparatus must be massive and strong in every part, and the greatest care must be taken to prevent arcing. We have had no trouble with controlling apparatus on our regular equipments, and we consider this branch of the apparatus well perfected.

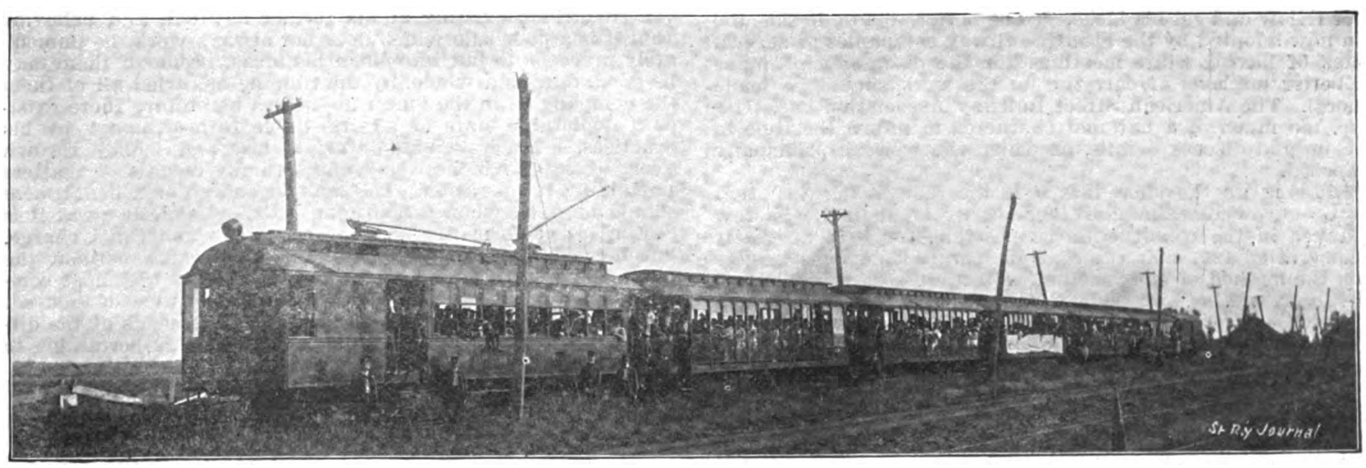
The danger to station and car apparatus from lightning discharges, which is so important a factor in street railroading where the overhead system is employed, is avoided in third-rail work, since the third rail is so close to the ground that it is practically a lightning arrester itself throughout its whole length.

The regular Westinghouse air-brake system, with engineer's valve, is used on our electric trains, but instead of steam air compressors, we have an electric motor compressor, controlled by an automatic regulator, which has given excellent satisfaction.

Our experience with trolleys on the overhead line at Nantasket Beach, originally put in two years ago, has not been satisfactory. The trolley difficulties have not interfered with the continuous operation of our line, but the cost of replacing wheels and poles has been rather large. These difficulties have had an important influence in causing us to reach a decision in favor of the third rail. The contact shoes which take the current from the rail to the motor circuit have given, on the whole, good satisfaction, although they are occasionally carried away by the approach blocks at grade crossings, when these blocks happen to be slightly misplaced so that the shoes strike them at the wrong angle.

STANDARD AIR-BRAKE INSTALLATIONS AT MASON CITY, IA.

Recently there were installed on the rolling stock of the Mason City & Clear Lake Traction Company, running from Mason City, Iowa, a number of Standard air-brakes. The service required of them was rather unusual. The company operates an electric locomotive which has been made out of a combination passenger and baggage car forty-five feet long. This was equipped with the Standard Air-Brake Company's 1½ h. p. electric compressor, governed by their automatic current controller. The locomotive draws a number of trailers, sometimes seven in one train. There are five open trailers, one closed trailer and one baggage and freight car, all of which are equipped with Standard air-brakes. The trailers have twenty double seats, with a centre aisle, and hold in seating capacity 80 passengers in addition to those that stand. This makes heavy traffic. The brakes, however, have proved fully equal to all demands made upon them. The en-



TROLLEY TRAIN WITH STANDARD AIR BRAKES AT MASON CITY, IA.

tire train of eight cars can be perfectly braked with a low consumption of air. The trailers require only one pound of air and the locomotive two pounds for effective braking per stop. The trains make a speed of from 30 to 32 miles per hour along the line. For about a mile there is a grade of 4 per cent. Our illustration shows the train, in the vestibule of which the Standard motor compressor is placed. An excellent opportunity for demonstrating the value of these air-brakes recently arose. The superintendent was running a train of locomotive and trailer, and while he was approaching the city with speed reduced to fifteen miles per hour a runaway horse with buggy attempted to cross the track. This buggy contained a woman and three children. The superintendent made an emergency stop, which brought the train to a standstill four feet away from the buggy, which had been overturned on the track by the frightened horse. The officials have been so pleased with the installation that they gave to the Standard Air-Brake Company a testimonial from which the following is quoted: "Our air-brakes have been put on by your Mr. Taylor and are working entirely satisfactory. This work was done in a workmanlike manner and according to contract, and we are well pleased with everything." It is a significant fact that the Standard system has been so well designed that it is only necessary to apply the air-brakes on the locomotive and three trailers in order to bring the whole train of eight cars promptly to a standstill.

SOME OF THE DIFFICULTIES EXISTING IN THE CONSTRUCTION AND OPERATION OF ELECTRIC STREET RAILWAYS.[1]

BY GEORGE W. KNOX.

THE first and most important step in working out economies is in selecting a corps of operators from the head foreman down to the man sweeping out the depot. If they are interested, and are working for the good of the company, scarcely an hour of the time in which they are engaged can go by without their effecting little savings which in time swell the item of economies to mammoth proportions.

In considering the question of our engines and electrical machinery we have reached a state of comparatively high efficiency and economy, and there is not the chance of making the saving on these lines, in either the designing or operation, that there has been in the past.

In the management of railway work the greatest opportunities for economy will be found in the details of construction and operation. It is totally out of the question for anyone to lay down a code of rules to be followed, owing to the varying conditions. One of the mistakes into which we are most liable to fall is the rut of self-satisfaction with our own style of work. Then it is that the manifestations of decay and inefficiency begin. It is imperative, in order to eliminate the difficulties with which we meet, that we brush up against the other fellow and get his ideas. To be better able to do this, the plan now adopted by the electric railway companies of several States of having State meetings for the discussion of plans for better methods of carrying on the work should be made general. The American Street Railway Association has, I believe, too much of a national character to afford the time to take up and discuss details, of which the work is principally composed.

Following up the idea—that it is the first wrong step that counts—our whole aim must necessarily be to make as few mistakes in the construction as possible, for it is an easily demonstrated fact that the cost of operation depends largely upon the method of construction. A little foresight, which results in preventing an accident, will probably mean the saving of the profits for many days' operation, one of the examples being, with ordinary conditions in the installation of overhead work, the use of but one insulation between positive and negative. For the first year or so this will be found sufficient, but a little later on the insulation begins to deteriorate, and there follow frequent short circuits and burnouts, which stop traffic and entail an expense many times the cost of the additional insulations.

Among the most important matters to study for economy connected with construction and operation is the supply department. There is an immense sum of money needlessly squandered in supplies and repairs for an electric road in a year. One of the causes of this waste lies in the fact that the roads have not yet arrived at a standard in the design of the apparatus which they use, to which too much importance cannot be attached. Every road should be its own designer of all articles used, for why should the manufacturer be better able to determine than you what is required? I mean in no wise to decry the assiduous and most excellent work of the manufacturers of electrical apparatus. It was and is a field of necessary inventive development, and the manufacturers are sparing no effort or expense in their endeavors to supply the trade with the improvements in demand, but the unwary railway man has had an immense amount of experimental clap-trap machinery inflicted upon him, all of which has cost dearly, and which is still maintained at a sacrifice. It is a lamentable fact that we have not done more than we have toward correcting this evil.

Along this line another evil for which the railway man is in his efforts to save money is in part accountable, is in the shaving of prices on material to the extent that it has resulted in competition being so sharp among the manufacturers of electrical supplies that they have adopted the piece work plan in order that cheapness may be secured, thus turning out upon the market apparatus that was not gotten out for efficiency, but to fill orders. The most carefully prepared specifications in detail should go out for every piece of apparatus used. To be able to get out the specifications needed it requires a certain amount of experimental work, and how far to go with this experimenting is a problem requiring the keenest discretion. Experimental work should only be encouraged and allowed by a company to the extent of having in view the elimination of an existing money wasting evil.

Another serious difficulty to be considered in connection with operation is the inefficiency of the motormen. The Board of Examiners for the fitness of employés on street railways will be able to make a better showing in efficient operation than most other departments, by giving more attention to the examination and instruction of operators, and that there is needed improvement in this particular is evinced by the magnitude of the accident account, which is due mostly to the operators not being properly schooled in the work they are handling. I do not believe in attempting to educate motormen to any extent in electrical knowledge, as it has been proven that it is a waste of time, and nothing is accomplished by giving them an insight into and encouraging them in determining the cause and remedy of some electrical trouble with which they may meet on their cars while on the road; you have men with all kinds of theories wasting the company's time in tearing apart and dissecting the equipment and perhaps not then locating the trouble, at the same time they are undoubtedly blocking the line; where, had they, after failing with the simpler methods of locating the trouble, called for an emergency crew, or been pushed into the depot, they would have been doing much better service. There are, of course, some cases where it is excusable for men attempting the locating of trouble on their cars, but, as a rule, it is found to be the wrong practice.

A company should, however, be governed with all cautiousness in making changes with heads of departments, also operators in general. A man assuming a new position usually comes loaded down with fertile ideas. They may have fitted perfectly the conditions existing at his former location, and believing that it is a poor rule which does not always work, he immediately proceeds to put into effect his ideas. Some of them may be good, but, as a whole, by the time he has tried all of them the company is, in the long run—unless heretofore there existed a deplorable state of affairs—liable to lose money by his practices. Much valuable time is lost and money thrown away by roads which are keeping so many records on matters partaining to operation. The man in charge of a department should be able, when called upon, to show exactly what it is costing to perform any part of the work under his charge, but he should be able to have this knowledge without the constant keeping of a lot of records. One of the most commendable practices employed in the maintenance of a street railway is the regular calling together of the heads of the different departments, for consultation on matters pertaining to their respective departments.

[1]Read before the American Street Railway Association at Niagara Falls. Abstract.

EXHIBITS AT THE STREET RAILWAY CONVENTION.

In our last issue we presented various illustrations and a great deal of data in regard to the exhibits at Niagara in connection with the American Street Railway Convention. We now supplement that matter with half a dozen more pictures, on an adjoining page. The descriptive text in regard to each will be found in our issue of October 21.

CHARLEVOIX, MICH.—A big new summer hotel here in course of construction collapsed last week killing two persons and injuring several. Among the injured was Charles Gabriel, the electric light contractor.

GLIMPSES OF SOME OF THE LEADING EXHIBITS AT THE NIAGARA STREET RAILWAY CONVENTION.

Exhibit of the Walker Company.

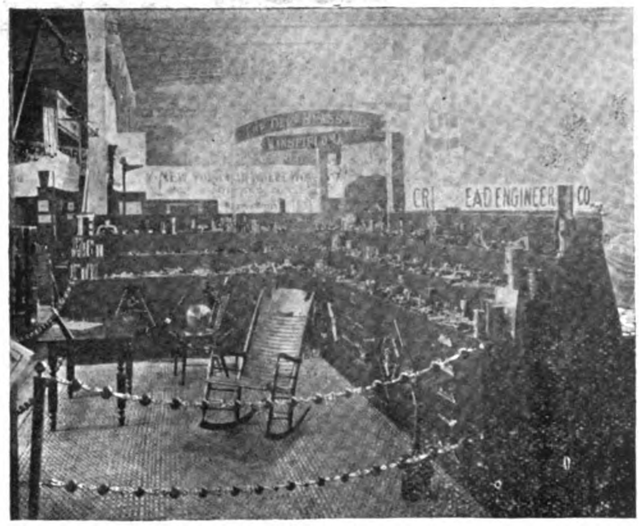


Exhibit of The Ohio Brass Co.

Exhibit of Creaghead Engineering Co.

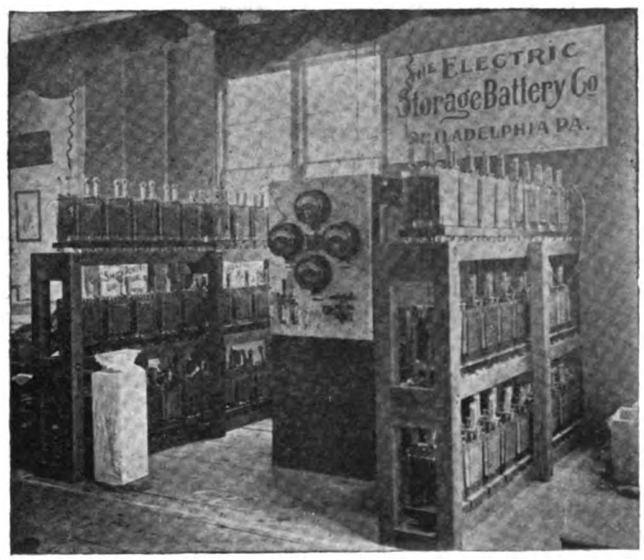


Exhibit of the Electric Storage Battery Co.

Corner of General Electric Exhibit.

Exhibit of The Central Electric Co.

PERSONAL

ALBION E. LANG.

ALBION E. LANG, the newly-elected president of the American Street Railway Association, was born in the year 1849 at Huntington, Lorain County, O. He entered the street railway business as owner of the Monroe & Dorr Street Railroad in Toledo, O., in 1881. At that time there were five other street railroads in the city, and in 1885 he succeeded in uniting these roads into one company under the name of the Toledo Consolidated Street Railroad Company, and of which company he became successively the secretary, vice-president and general manager, and president. Later on the Consolidated Company acquired two other companies, and a second

ALBION E. LANG.
President American Street Railway Association.

consolidation ensued, under the name of the Toledo Traction Company, of which Mr. Lang has been president since its organization. Mr. Lang was president of the Ohio State Tramway Association in the year 1893. He is also the president of the Toledo Consolidated Electric Company, and that company and the Traction Company control all the street railway and electric light properties of Toledo, a city of 135,000 inhabitants. Mr. Lang has been an interested attendant at all the conventions of the association since the Washington meeting, in 1888, except the Atlanta and Montreal meetings. It will be remembered that a very full and complete description of Mr. Lang's fine new power house at Toledo appeared in the first issue of The Electrical Engineer for the current year.

MR. O. T. CROSBY was one of the expert witnesses called recently as to the electrical details and estimates of the proposed work on the New York underground road.

OBITUARY

IRA T. BRITTON.

We regret to note the death at New Orleans on October 20, from yellow fever, of Mr. Ira T. Britton, general manager there for the General Electric Company. He went South a year ago and previously was connected with the Brush interests in Cleveland. He was well known and popular in electric lighting circles throughout the country.

LEGAL NOTES

WESTERN UNION BEATEN ON APPEAL IN TELEPHONE LITIGATION.

At Boston on October 15 the United States Circuit Court of Appeals ordered a mandate to issue in the case of the Western Union Telegraph Company against the American Bell Telephone Company, in accordance with an opinion filed by the Court in September, 1895. The case is one in which the Western Union Telegraph Company demanded heavy damages on account of a contract, by the terms of which it claimed to be entitled to a percentage of the earnings of the sub-companies of the American Bell system.

The case was brought in the United States Circuit Court and was referred to Judge Lowell as master. He heard the case and prepared a report in favor of the Bell Company. As soon as the Western Union's counsel ascertained this fact he moved to have his bill dismissed. The Circuit Court entered a decree, allowing the bill to be dismissed, and the Bell Company appealed to the Circuit Court of Appeals, which decided in favor of the appellant. Counsel for the Western Union then appealed to the United States Supreme Court for a writ of certiorari to review the proceedings of the court below, but the motion was denied on April 12.

The Circuit Court of Appeals sent notice to counsel that the mandate would issue at once. The result is that the case now goes back to the Circuit Court, and the Western Union Company must either allow a decree against it on the master's report, which would end the litigation, or go on and have a trial.

SUITS OF THE STANDARD UNDERGROUND CABLE CO. AGAINST THE NATIONAL CONDUIT AND CABLE CO.

WE are in receipt of the subjoined from the Standard Underground Cable Company:

Buyers and users of underground and ærial electric cables will be interested to learn that the Standard Underground Cable Company, of Pittsburg, Pa., has entered suit against the National Conduit and Cable Company, of New York, for infringement of a number of its patents on cables, terminals, "T" joints, etc. The following patents are involved in the suit:

No. 242,894, relating in general to a duplex or two conductor flat form of cable for telephone, telegraph or electric light service, this form of cable being especially economical in manufacture and installation, and especially well adapted, owing to its practical elimination of self-induction, for alternating current transmission.

No. 388,477, relating to what might be termed a "semi-concentric cable," composed of a central conductor or core, and a number of insulated conductors arranged spirally around the same, and having a cross section greater in breadth than thickness, and composed of a number of smaller wires or strands, the purpose being to produce a flexible cable of the smallest dimensions, and also, by the position of the wires with respect to each other, and by including them under one lead cover, to reduce self-induction to a minimum, all of which are desirable and valuable features in electric light service.

No. 371,808, which is believed to cover generally the so-called "T-joint," or a metallic case or protecting shield secured around the insulated conductor joints between the main and branch cables. It would seem that a device of this kind is practically indispensable wherever branches or loops are to be taken from a lead covered main or trunk line cable.

No. 395,546 is for a coating of tin or alloy thereof, or other material more durable than lead, as a protection against mechanical injury to the softer lead cover of the cable, and to resist the oxidizing action of acids, alkalies and similar agents that might work the destruction of a plain lead covering.

No. 574,343 relates to the well known cable terminal head, tubular in form, and split in two longitudinal sections for convenience of joining the cable conductors to their respective binding posts, the sections being made of substantially uniform cross-sectional shape throughout their entire length and of such internal dimension as to make a tight joint with the cover of the cable when applied thereto, and provided with binding posts for connection with the cable conductors and the exterior distributing wires.

The suit has been entered in the United States Circuit Court for the Southern district of New York by Kerr, Curtis & Page, of New York City, as solicitors, and George H. Christy of Pittsburg, Pa., and Thomas B. Kerr, of New York City, of counsel, and it is expected that these suits will be pushed to a speedy trial and decision.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCTOBER 19, 1897.

Alarms and Signals:—

COMBINED AUTOMATIC BLOCK AND SIGNAL SYSTEM AND BRAKE AUTOMATIC APPLIANCE. J. G. Pearce, Oakland, Cal., 592,120. Filed April 3, 1893.
Comprises a combined automatic block signal system and automatic brake appliance.
CAR SIGNAL. C. E. Miller, Minneapolis, Minn., 592,158. Filed May 5, 1896.
Composed of foldable blades apertured near their free ends, an electric light held in the aperture of each blade, and circuit wires flexibly connecting all the lamps to a source of electricity.

Batteries, Secondary:—

ELECTRODE FOR STORAGE BATTERIES. H. S. Lloyd, Philadelphia, Pa., 591,855. Filed March 15, 1897.
Comprises a frame, formed of lead, extending between the side bars of the frame, and a perforated leaden plate situated between the layers.

Conductors, Conduits and Insulators:—

INSULATED ELECTRIC CONDUCTOR AND APPARATUS FOR MAKING SAME. J. D. Bishop, New York, 591,997. Filed June 7, 1897.
Comprises an insulated conductor inclosed within a paper tube of greater inside diameter than the conductor, having overlapping, longitudinal, sealed edges.
INSULATING COUPLING FOR ELECTRIC WIRE CONDUITS. L. McCarthy, Boston, Mass., 592,016. Filed July 2, 1897.
Comprises opposite connections made tubular for the reception of conducting wires, and an interposed insulator, and having at opposite sides of the insulator lateral passages to permit the wires to be withdrawn and passed around the exterior of the insulator.
ELECTRIC CONDUCTOR WIRE CONNECTOR. I. Shultes, Martin, Mich., 592,025. Filed April 2, 1897.
Means whereby a broken section of wire may disengage from the connector and fall to the ground.

Distribution:—

ELECTRIC TRANSFORMER. W. S. Moody, Lynn, Mass., 591,869. Filed May 20, 1897.
The primary and secondary windings are separated by an air space.

Dynamos and Motors:—

ELECTROMAGNETIC ENGINE. W. Mont Storm, New York, 591,897. Filed Dec. 8, 1896.
Adapted for light power uses; details of construction.

Electro-Metallurgy:—

PROCESS OF TREATING ORES. E. C. Ketchum, Boston, Mass., 592,055. Filed Nov. 21, 1896.
Electrolytic process for the extraction of metals contained in mixed sulfid ores.
ELECTROLYTIC APPARATUS. B. Moebius and G. Nebel, New York, 592,097. Filed July 6, 1897.
Comprises an oiling device for endless silver belts employed in electrolytic tanks for the separation of silver.

Measurement:

DAMPER FOR ELECTRICAL MEASURING INSTRUMENTS. E. Thomson, Swampscott, Mass., 591,898. Filed July 22, 1897.
Consists of a moving member, a brake piece, and a coil inducing an alternating magnetic field acting upon the brake piece to alternately apply and release it.

Miscellaneous:—

ELECTRICAL CURRENT INTERRUPTER. H. W. Mather, Roseville, N. J., 591,861. Filed Feb. 17, 1897.
A strip for an electrical current interrupter stencil, made of paper.
REGULATING ROENTGEN RAY TUBES. E. Thomson, Swampscott, Mass., 591,899. Filed Aug. 4, 1897.
Employs an extension from the main tube containing a substance volatilizable by heat, and a separate exhausted bulb registering with the extension and included in a shunt around the main tube.
ELECTRICAL STEERING GEAR. J. D. Williamson, Jr., Philadelphia, Pa., 591,995. Filed May 15, 1894.
Comprises two fixed plates provided with contact points in circuit, a movable contact arm on one of the plates, and a rotary plate on the other of the plates provided with a series of contact plates in combination with an electric motor.

Railways and Appliances:—

ELECTRICAL TRACTION. W. Kingsland, Llandudno, Eng., 592,056. Filed March 5, 1897.
Method of connection and disconnection of auxiliary sectional conductors.
TRAVELING CONTACT DEVICE. E. Lundqvist, Pittsburg, Pa., 592,150. Filed Oct. 28, 1896.
Comprises a wheel having recesses concentric with it, and an elastic continuous ring of electric conducting material supported by the walls of the recesses.
ELECTRICAL RAILWAY. R. M. Hunter, Philadelphia, Pa., 592,225. Filed June 12, 1897.
Means whereby a plurality of cars may be controlled through one controller.
MOUNTING FOR CONTACT SHOES OF SURFACE CONTACT RAILWAYS. W. B. Potter, Schenectady, N. Y., 591,878. Filed June 19, 1897.
Comprises a support substantially rigid at one end, and having a certain play at the other, with springs between the shoe and the support.
ELECTRICALLY OPERATED RAILWAY GATE. J. S. Biggar, Chicago, Ill., 591,911. Filed July 29, 1895.
Comprises a pivoted gate arm, provided with a bearing shaft, an electric motor connected directly with the shaft and adapted to rotate the same to operate the gate, and electrically controlled means independent of the motor for holding the gate in a lowered position.
ELECTRIC CAR TRUCK. E. Lundqvist, Pittsburg, Pa., 592,151. Filed Dec. 29, 1896.
Details of construction.

Regulation:—

ELECTRIC CONTROLLER. H. G. Reist, Schenectady, N. Y., 591,879. Filed March 9, 1897.
Adapted for alternating current induction motors; employs separate switches for the primary and secondary circuits of the motor.
CONTROLLER. T. Von Zweigbergk, Cleveland, O., 592,104. Filed April 3, 1897.
In combining a series wound electric motor and a controller adapted to entirely open the circuit through the field of the motor, means for short circuiting the field just after the controller has opened the circuit.

Switches, Cut-Outs, Etc.:—

ELECTRIC PUSH BUTTON. E. H. Stanley, Lake Geneva, Wis., 591,895. Filed Dec. 18, 1896.
Dispenses with the screw threaded back plate commonly employed.
FUSE BOX. A. W. France, Philadelphia, Pa., 591,917. Filed March 30, 1897.
Details of construction.
AUTOMATIC MAGNETIC CIRCUIT BREAKER. W. M. Scott, Philadelphia, Pa., 592,100. Filed March 17, 1897.
Details of construction.
ELECTRIC SWITCHBOARD. G. W. Ribble, Hyattsville, Md., 592,123. Filed Aug. 19, 1897.
Comprises a terminal formed with a depression having an undercut of overhanging sides, and a marked disc fitting in the depression engaging beneath the sides and removably held thereby.

NEWS AND NOTES

ELECTRICITY DECIDED UPON FOR TURRET TURNING IN THE U. S. NAVY.—THE LEONARD SYSTEM ADOPTED.

For several years past the United States Navy has been experimenting with electric power for turret turning on the men-of-war, but the former method employing hydraulic power was strongly preferred by the authorities until the "Brooklyn" was equipped with the electric gear about a year ago. Since then there has been a vigorous discussion as to relative merit of the electric method versus the hydraulic. When the "Brooklyn" went to England at the time of the Queen's Jubilee, the exceptionally perfect performance of the electric gear attracted great attention from the English naval constructors and engineers. When she returned to this country the discussion as to the best method of turret turning became very lively. Finally, a few days ago, after many tests and reports had been made, the electric gear was demonstrated to be so superior in every way to the hydraulic that the Navy Department decided to equip the "Kearsarge" and "Kentucky" with it, and also to abandon work on the hydraulic gear for the turrets of the "Alabama," "Illinois" and "Wisconsin" and to substitute the electric gear on these battleships also.

The superiority of the electric gear is due to the perfection and simplicity of the control, which is attained by the use of the system of electric motor control invented by Mr. H. Ward Leonard. Mr. Leonard's claims regarding his system for this and similar purposes, where variable speed and reversibility of motion under perfect control were demanded, have been stoutly maintained by him for years past, against strong attacks from many of the best engineers in this country and abroad, and he is to be congratulated on the victory his system has won in favor of electricity for this very important use.

The General Electric Company, who are licensed to use Mr. Leonard's patents under royalty, installed the equipment on the "Brooklyn," and have also secured the contracts for the equipments on the new battleships named above.

THE STOCK MARKET

STEADY AND GOOD CONDITIONS.

Although the trade of the country continues to improve steadily on the whole, it has its necessary fluctuations and these depend on many elements other than those of demand and supply—such as drouth or heavy snow, yellow fever, war scares and the like. But it is evident that the business of the country, even in spite of things tending in a measure to check

it, still holds on its way of betterment. In many fields prices are higher. Our exports are still very large and unusual.

Stocks this week are dull and firm and the tendencies appear to be upward again. The market is not very active. Western Union is quoted at 88¼; General Electric at 33¼ and American Bell Telephone at 261. In Philadelphia Electric Storage Battery common is up to 28½.

TRADE NOTES & NOVELTIES

THE ELECTRO-DYNAMIC CO.'S REVOLUTION INDICATOR.

A REVOLUTION indicator differs altogether from a revolution counter, owing to the fact that it shows, by means of the pointer on a dial, the actual rate of speed at any moment, instead of simply counting the number of revolutions in a certain time. The Electro-Dynamic Company, of Philadelphia, has lately brought out a revolution indicator involving principles entirely different from any instrument of the kind yet introduced.

The working of this machine is electrical, and is based upon the fact that voltage generated by an armature revolving in a constant magnetic field is proportional to the speed; therefore the voltage can be made an index of the number of revolutions made by any revolving shafting or machinery, and a voltmeter graduated in revolutions instead of volts can be

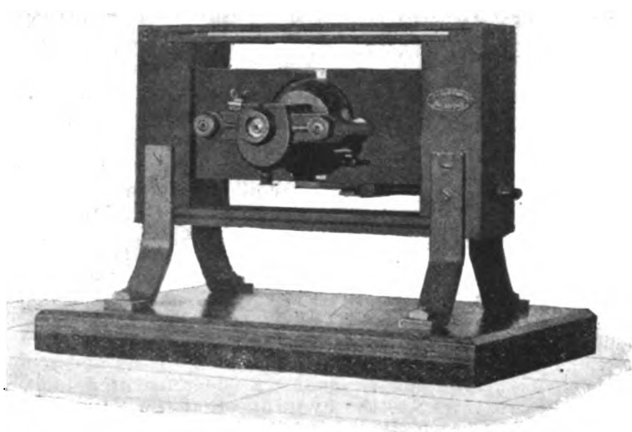


FIG. 1.—GENERATOR FOR ELECTRIC REVOLUTION INDICATOR.

made to show at any moment the speed at which the generator is revolving.

The generator is a magneto machine, shown in Fig. 1, differing from a dynamo, owing to the fact that it has permanent magnets for the fields. The machine is belted to the engine or other shaft whose speed is to be indicated, and from it wires lead to the indicator dial, which is a simple voltmeter, graduated to read revolutions instead of volts.

The field must be of constant strength, in order that the voltage produced may be proportional to the speed. To accomplish this the magnets are manufactured of a special grade of steel. The armature is of the ironclad type, running close in the field bore, and thus acts also as a keeper to the magnets, and so assists in preventing any deterioration in the strength of the magnetic field. Should any small variation in magnetism occur in time, means of regulating the machine are provided by an adjustable magnetic shunt in the air gap. The dial indicators, Fig. 2, are also capable of adjustment and correction, both for zero and for amount of deflection. These adjustments are simple matters, based on comparing the readings of the indicator with those of an ordinary revolution counter.

The important feature of this apparatus not exhibited by any mechanical indicator, is that any number of dials may be connected to the same generator, and be placed in widely separated locations. For example, in a manufacturing establishment or mill, dials may be put in the superintendent's office, the engine room, or wherever desired.

In its application to marine engines this indicator has filled a "long felt want;" in fact, the apparatus is intended principally for this class of work, as not only does it show the number of revolutions, but also the direction of turning; for should the generator be reversed, the direction of the current will be reversed also, and at once shown on the dial by the pointer moving to the opposite end of the scale. In marine use it is customary to have dials in the chief engineer's room and on the bridge of the vessel.

One of the objects of the apparatus in marine work is to enable the two engines of a twin-screw ship to be kept as nearly as possible at the desired speed. This enables the

FIG. 2.—ELECTRIC REVOLUTION INDICATOR.

rudder to be kept amidships on a straight course, avoiding the drag due to its being kept at an angle. One of the Atlantic greyhounds claims to save over two hours in a trip as a result of being able to regulate the engines and keep the rudder central. This apparatus is installed on the ships of the American line, some of the new ships of the navy, several yachts and other steam vessels.

MANHATTAN ELECTRICAL SUPPLY CO'S. CATALOGUE.

With the revival of trade many firms have found it necessary to revise their old catalogues and to bring them up to date by including the numerous new things which have been called into life by the bettering business conditions. Among those who have felt this necessity are the Manhattan Electrical Supply Co., of 32 Cortlandt street, New York. This well-known firm have long since made a specialty of telephone, telegraph and battery supplies, while not less alive to the wants of users of electric light and household electric goods. Their new catalogue No. 9 is a perfect cyclopædia on all that is included in the above categories, and it would be difficult to find a piece of apparatus or a supply material not mentioned within its covers. The catalogue is profusely illustrated and accompanied by a very comprehensive index, so that no time need be wasted in hunting up the article desired. Every user of electrical supplies of whatever nature will find it useful to have the Manhattan catalogue at his elbow. It can be had on application.

SIBLEY & PITMAN.

A concern of the above name is now in active business at 59 Duane street, New York, handling electrical supplies of all kinds. Its members are Mr. C. C. Sibley, formerly of the company bearing that name, and Mr. G. D. Pitman. They have fine storage capacity and carry a large and complete stock of electric light, bell and house wiring supplies.

RECEIVER ASKED FOR HAMILTON, O.

A special dispatch of Oct. 24 from Hamilton, O., says: The Post-Glover Electric Company of Cincinnati filed a petition yesterday in the Common Pleas Court of Butler County, praying for the appointment of a receiver for the city of Hamilton. The petition alleges that the city, through corrupt mismanagement, has been brought to insolvency, that the funds have been so depleted in the treasury that the city cannot meet its obligations, and that the public schools will have to be closed, etc. The petitioners are creditors of the city of Hamilton for machinery and supplies.

THE NEW YORK ELECTRICAL EXHIBITION OF 1898.

The Electrical Exhibition Company, under whose auspices the Second Electrical and Kindred Industries Exhibition will be held, in May, 1898, have closed a lease for the Madison Square Garden building, New York. The amphitheater, with arena circles, concert hall, assembly hall and machinery hall in the basement, affords a total of over 100,000 square feet

of floor space, considerably more and better adapted for the purpose than that afforded at the last show.

NEW YORK NOTES

SEARCHLIGHTS are coming into quite extensive use for all kinds of signaling, and recently they have been very extensively used for signaling election returns. The New York "World' has for the last few years used this method with such success that it will this year make an effort to beat all previous records and has contracted with the Rushmore Dynamo Works to furnish powerful projectors for the different parts of the city, one on the dome of the "World" building, and one on the great Ebling Brewery, and one on the tall tower at Fort George. In addition there will be a number of the largest on the roof of the tall Rushmore factory on the Jersey water front opposite Cortlandt street. All these lights will be flashed according to a widely advertised code of signals and as each beam will be clearly visible for over thirty miles, anyone in Greater New York or the surrounding country may know at once the results of the election without leaving his house.

HEBER WELLS, 155 William street, this city, carries a complete stock of pattern letters for castings. White metal and brass letters are both in his line. He has large cabinets of drawers filled with various styles, from ⅛-inch to 3 inches or more in size. Mr. Wells will be glad to answer correspondence.

ECK DYNAMOS AND ELECTRIC MOTORS, manufactured by C. A. Eck, of Newark, N. J., are among the best up-to-date apparatus now on the market, combining perfect electrical proportioning, high efficiency, high insulation, simplicity of mechanical design, first-class workmanship, materials, etc. Messrs. Goldmark & Wallace, 29 Chambers street, New York, selling agents for Eck motors and dynamos, report having made quite a number of sales recently.

PURITAN ELECTRIC CO., 150 Nassau street, report business very good and that they have booked large orders for their lamps.

THE STANDARD ELECTRIC CONSTRUCTION COMPANY, 32 North Water street, Rochester, N. Y., recommend Freeman's electric soldering compound and state its many advantages.

A. A. McCREARY, 136 Liberty street, has booked orders for months ahead on his large line of lamp shades.

MR. I. P. FRINK, 551 Pearl street, New York, has recently installed his patented system of reflectors in the art galleries of the following prominent department stores: Abraham & Straus, Brooklyn, N. Y.; Bloomingdale Bros., R. H. Macy & Co., New York; Hahne & Co., Newark, N. J.

A. O. SCHOONMAKER.—To accommodate his Western trade A. O. Schoonmaker, importer and dealer in mica, has placed a stock of his well known India and amber mica with his agents: John Child, Monadnock building, Chicago; Hayes & Arthur, Cuyahoga building, Cleveland; Central Union Brass Company, St. Louis; Reger & Atwater, 36 Second street, San Francisco. Orders sent to these parties will be filled with his usual promptness and at his best prices.

SYRACUSE, N. Y.—Mrs. W. J. Blackburn, of New York, wife of a theatrical electrician, has been wiring the new Wieting Opera House for 1,250 lights. She likes the work and has done a lot of it.

EDISON ELECTRIC ILLUMINATING COMPANY, Brooklyn, has won a victory in the courts over its personal property tax, and an order for the refund to it by the city of $1,701. The decision holds that companies paying a direct State tax cannot be locally assessed again for State purposes, except on real estate.

WESTERN NOTES

OMAHA EXPOSITION.—Manager Kirkendall has been authorized to make arrangements with Mr. Luther Stieringer to prepare certain electrical plans for the Exposition, and to act as its consulting electrical engineer. It will be remembered that Mr. Stieringer filled a similar capacity at the Chicago World's Fair and designed the famous electrical fountains.

TERRE HAUTE, IND.—The firm of Wells & Beebe, electrical contractors, has been dissolved. Mr. George E. Wells has taken a position as head of the construction work in the shops of C. W. Hatfield at Indianapolis. Mr. Beebe will continue the business alone.

ELECTRIC APPLIANCE COMPANY, Chicago, have recently very much increased their stock of clay tubes and bushings for electric wiring and are now prepared to furnish promptly from Chicago stock clay tubes in any size and of any length up to twenty-four inches in unlimited quantities. The demand for wiring tubes has increased very much of late, and the clay tube seems to be in general favor on account of its economy and its power to stand rough handling. The breakage in clay tubes being considerably less than the porcelain goods, the Electric Appliance Company will make a specialty of shipping any kind of an order for clay tubes promptly from Chicago stock.

CHARLES E. GREGORY COMPANY will remove about November 1 to their handsome new quarters (occupying the entire building) 58 to 62 South Clinton street, Chicago, and will carry as usual their full line of new and second-hand apparatus. This is said to be the largest repair shop in the world, and the move is due to large increase of business. Mr. Gregory has worked hard to build up a trade based on a reputation for fair dealing, and has now a wonderfully large business.

THE RELIABLE ELECTRICAL SUPPLY COMPANY has opened offices at 236½ East Madison street, Chicago. The new concern deals in incandescent lamps, switches, interior conduits, bells and batteries, wires, ammeters and a full supply of electrical goods. The organizers of the Company are Julius Harris and Otto Reiman. Mr. Harris is a newcomer in the electrical field, but is well known in real estate circles and a good financier.

Mr. Reiman has been two years with the Central Electric Company as auditor and has been the credit and financial man of the Metropolitan Electric Company, and is very well known around the electrical houses in Chicago and the West.

ST. PAUL, MINN.—A proposition has been submitted to the joint council committee on gas by Ald. Albrecht, for the establishment of an electric light plant in this city with a capacity of 550 arc lights, and the resolution was prefaced by the submission by Gustave Willius, Jr., an electrical engineer, of a plan for a plant of 1,500 arc lights. His estimate of the cost of such a plant was $325,842, and the annual cost of operation $84,750, making the cost of each arc light $56.50 a year, not counting interest on the bonds, depreciation.

THE CUTTER-HAMMER MANUFACTURING COMPANY, Chicago, Ill., say they have sold 8,000 of their motor starters during the five years they have been on the market. They claim that while they cost more than any other, they are worth it.

PHILADELPHIA NOTES

MR. GEORGE E. PRATT, the late secretary and general manager of the Hunt Air Brake Company, of Pittsburg, has severed his connection with that concern and entered the service of the Standard Air Brake Company as special agent. Mr. Pratt was an earnest worker in the air-brake field, and as he thoroughly believes in air-brakes, has decided to continue in the business. He had a thoroughly good opportunity while in the Hunt Company of becoming acquainted with the merits of Standard air-brakes. We predict for him a long and successful career in this field. His hosts of friends will doubtless be interested on learning of this new connection. It is certain that Mr. Wessels is surrounding himelf with the best representative men in the various branches of the Company's business.

MARIS BROS., manufacturers of traveling cranes, Philadelphia, are erecting a new machine shop to meet the demands of their increased business, and the new building will be modern and designed to meet the requirements of a handy and serviceable machine working establishment. The building will be 55 feet by 75 feet. Running the full length of the building will be a 10-ton power crane, having a span of 30 feet. One side of the building will be arranged with a gallery, on which will be placed the lighter machinery. The framework of the building is of steel, and the covering of the sides and roof will be corrugated iron. Contract for the complete building has been let to the Berlin Iron Bridge Company, of East Berlin, who designed the structure, and who will furnish and erect all the material.

THE D'OLIER ENGINEERING COMPANY, of 129 South 11th street, Philadelphia, announce that they have added steam engineering and construction to their business of electrical engineering, construction and manufacturing, and are prepared to fill orders and execute contracts for complete steam plants and electric power and light installations. In addition to their established lines of electrical apparatus and ap-

pliances they have recently assumed, for this district, the sole agency for the Ball Engine Company, Erie, Pa.

THE HELIOS ELECTRIC COMPANY have added another floor to their already large factory, at 1227 Callowhill street. Never in the history of the company have they had so many orders for arc lamps as now.

ADVERTISERS' HINTS

NEW ENGLAND NOTES

WASHBURN & MOEN MANUFACTURING COMPANY, of Worcester, Mass., furnished all the trolley wire, feed wire, rail bonds, span wires, etc., for the entire Lorain & Cleveland Railroad, described Oct. 14. They also furnished all the similar material for the Cleveland, Painesville & Eastern Electric Railway Company, and large quantities of material for all the other roads in and around Cleveland.

THE BERLIN IRON BRIDGE COMPANY have a contract for furnishing and erecting the structural iron work of floor and roof of a cow barn for the Connecticut Hospital for the Insane at Middletown, Conn. The building is 50 feet wide and 200 feet long. Under a portion of the building is a cellar for the storage of root crops and other farm products. The floor of the barn proper over the cellar is supported by steel beams and brick arches. The roof and interior supports of the stalls are of steel. Every precaution has been taken to make this new barn fire-proof, and to make it an up-to-date, permanent, handy and economical structure.

DERRY, N. H.—The Derry Electric Light Company has had built for its station by the Dillon Boiler Works, of Fitchburg, Mass., two upright Manning boilers of 175 h. p. each.

FOREIGN NOTES

MR. LUDWIG HOMMEL, of the staff of electrical engineers of the Standard Underground Cable Co., has sailed for Costa Rica to take charge of the construction of the new telephone and electric light plant at San Jose City, the capital of that country. This will be a matter of interest to the many friends which Mr. Hommel has made while in Pittsburg doing work for the Standard Underground Cable. Co.

THE UNION ELEKTRICITAETS-GESELLSCHAFT, of Berlin, Germany, have removed their offices from their old address, Hollman-strasse, No. 32, to Dorotheen-strasse, 43 and 44.

THE PROVINCIAL EXHIBITION of Nova Scotia is just now being held. The local papers pronounce it a grand success and give glowing accounts of the electrical exhibit of John Starr, Son & Co., limited, Halifax, which is said to surpass anything hitherto seen in Canada, as a general exhibit of all kinds of electrical apparatus. It was visited by Lord and Lady Kelvin, the Governor General, Lord Aberdeen, and the Countess of Aberdeen, Admiral Sir John Fisher and Lady Fisher and a host of celebrities, who were much interested in the electrical novelties displayed, and Lord Kelvin expressed himself as highly pleased at the exhibit. The Countess of Aberdeen handled the main switch and the branch switches in turning on the current at the switchboard with the dexterity of an expert.

SOUTHERN NOTES

BALTIMORE & OHIO RAILROAD is having built ten express cars for the use of the United States Express Company on the B. & O. lines. These cars are to be 60 feet in length, of extra strength and so arranged that they can be used for the transportation of fine horses. They will be fitted up with removable stalls and when not used for horses will be placed in regular service.

KNOXVILLE, TENN.—The People's Telephone Company, of this city, are preparing plans for a fireproof building, which is to be occupied exclusively by this Company. The building will be constructed with great care and will be built with a view to putting the wires underground through the entire fire limit. They will also put in an up-to-date switchboard, both for the general exchange and for toll lines.

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The Electrical Engineer.

VOL. XXIV. NOVEMBER 4, 1897. No. 496.

ELECTRIC LIGHTING

TESTS OF THE ILLUMINATION OF THE ROTUNDA IN THE BUILDING FOR THE LIBRARY OF CONGRESS.

BY DR. CARY T. HUTCHINSON.

THE general appearance of the great rotunda or reading room of the new Library of Congress Building is shown in the accompanying engraving, Fig. 1. The plan is an octagon, having a diameter of nearly 100 feet, and a height of 82 feet, surmounted by a dome, slightly flattened, having a height of 40 feet; this dome is topped by a lantern, with a diameter of 20 feet and height of 25 feet, which is finished by a small dome.

The interior, up to the springing line of the window arches,

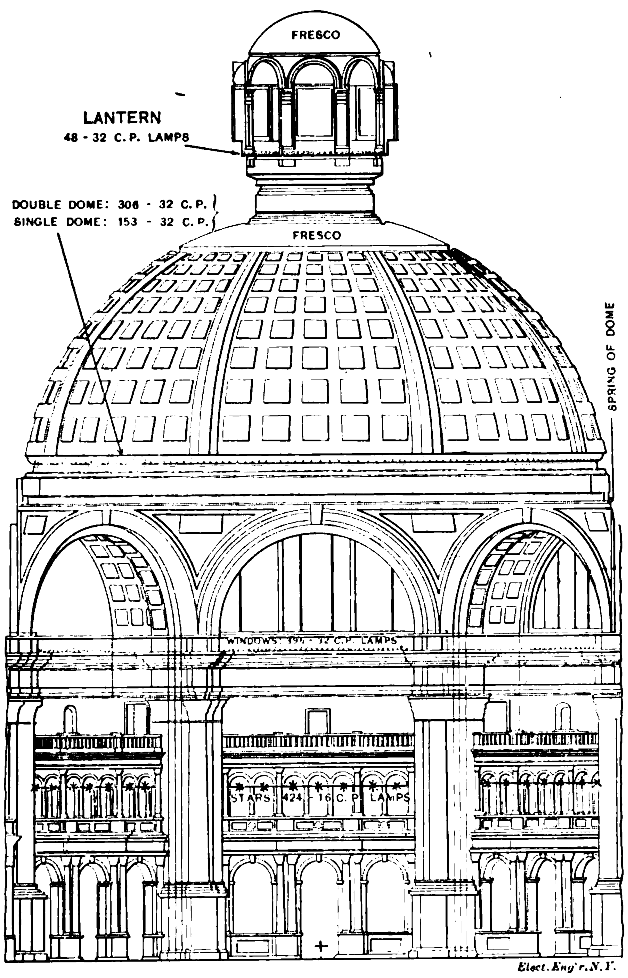

FIG. 1.—LIGHTING ARRANGEMENT OF THE READING ROOM AND DOME OF THE LIBRARY OF CONGRESS, WASHINGTGN.

is mainly polished marble, of medium to dark colors; from this point to the springing line of the dome it is stucco and fresco work, in medium tones; the main dome is finished in coffers; the interior of the dome of the lantern is an oil painting. There are a number of statues and paintings in various parts of the rotunda, all of which must be well lighted.

The floor space is about 8,500 square feet, and the volume approximately 1,000,000 cubic feet.

The lights are on four levels, arranged symmetrically around the octagon. The first line is that of the "Stars," at a height of 29 feet from the floor, comprising 53 Stars, each of eight 16 c. p. lamps, a total of 424 16 c. p. lamps. These are suspended by special fixtures across the springing line of the small arches of the first gallery. These lamps have no re-

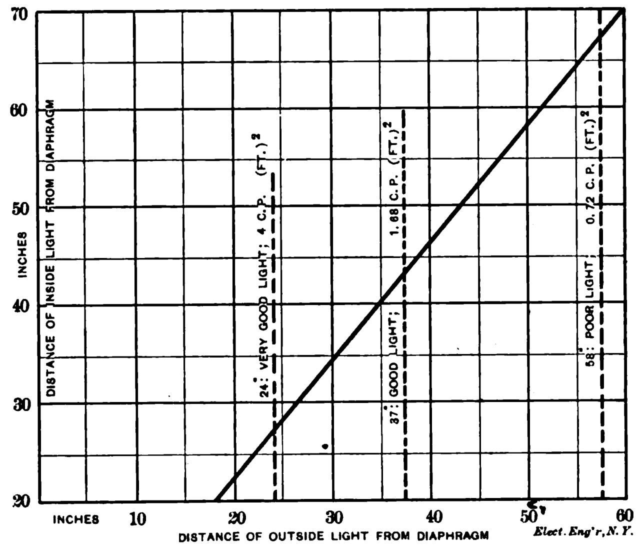

FIG. 2.—TEST OF LIGHTING OF CONGRESSIONAL LIBRARY, WASHINGTON,

flecting surfaces behind them, but serve to illuminate the book alcoves.

The second line is at a height of 52 feet from the floor and is composed of eight groups of 50 32 c. p. lamps; these lamps are arranged in one line at the bottom of each of the eight

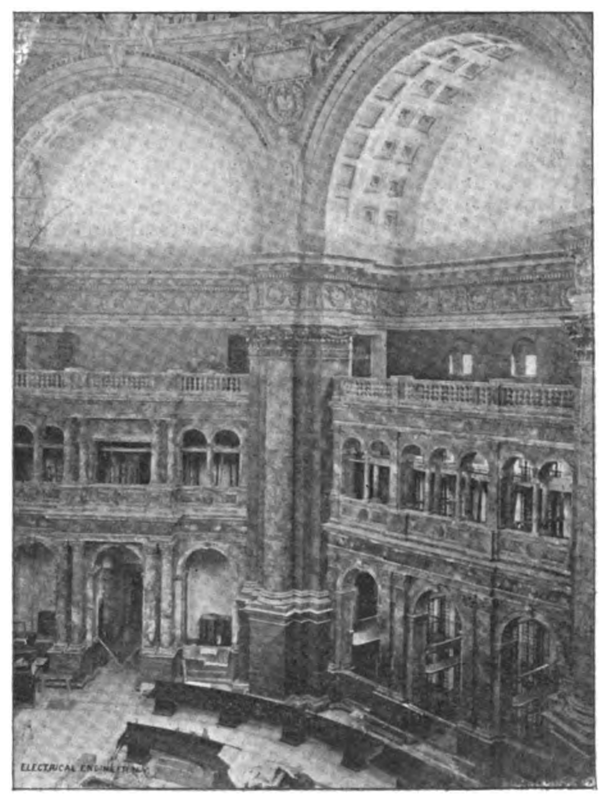

FIG. 3.—ROTUNDA OF LIBRARY OF CONGRESS BUILDING.

large windows; the window back of them serves, in part, as a reflector.

The third line is at the base of the main dome, 84 feet above the floor; the lamps are arranged uniformly around the circle and connected alternately in two circuits; each circuit has 153

32 c. p. lamps, making a total of 306 lamps. The lamps are set back slightly, and are partly visible from the floor; the dome serves as a reflector.

The fourth line is at a height of 135 feet; the lamps are strung around the base of the lantern and are not visible from the floor; there are 48 32 c. p. lamps. They are intended primarily to illuminate the painting on the small dome. The total number of lamps is, then, 424 16 c. p. and 750 32 c. p., making a total of 30,784 c. p., and demanding 95 kilowatts.

The tests were made by measuring with a photometer the illumination given by various combinations of circuits; the photometer was a rough affair, made for the purpose; it consisted of a box eight inches square and six feet long, with the inside surfaces thoroughly blackened; one end was closed by a sheet of paper with a grease spot at the center; the other by a block through which passed a rod carrying at the inner end a 16 c. p. lamp; the rod was movable, and was properly graduated to give the distance of the lamp from the diaphram. In all the illumination tests the plane of the diaphram was horizontal and about 2.5 feet from the floor; the photometer box projected through the floor.

TABLE I.

Location.	Number of Lamps. 16 c. p.	Number of Lamps. 32 c. p.	Total C. P.	Vertical Height. Ft.	Distance. Ft.	Illumination. Cp.÷ft.²	Per cent.
Stars (S)	424	..	6,784	27	62	0.77	26
Windows (W)	..	396	12,672	50	83	1.10	38
Dome (2D)	..	306	9,792	82	95	.94	33
Lantern (L)	..	48	1,536	132	133	.09	3
Total	424	750	30,784	..	..	2.90	100
One Circuit of Dome (1D)	..	153	4,896	82	95	.47	16.5

The photometer was compared with an outside light by placing it horizontally, with the outside light in the prolongation of the axis of the box; these tests were made at night with no other light in the room; the point of the outside lamp was directed toward the diaphram. In this way the distance of the photometer lamp for various distances of outside lamp was obtained; the curve in Fig. 2 shows this comparison; ordinates are the distances of photometer lamp; abscissæ, of the outside lamp. The room is so large that reflection was not appreciable. At the same time a page of brevier type was placed on the diaphram and the distance of the lamps for "very good," "good" and "poor" illumination was estimated by the observers. This is, of course, a matter of individual judgment, and is very rough. It is added merely as a general guide.

The tables give the data and results of the test. Table I shows the number of lamps in each set, the total candle power, the vertical height and the slant distance of a lamp from the diaphram; it also gives the theoretical illumination of each set calculated by the formula, $c.\,p./ft.^2 = c.\,p. \times h/d^3$, making no allowances for reflection; and the proportion of the total illumination supplied by each set. The dome set is double, as stated, and the data is given for both circuits.

Table II records the result of the experiments. Column 1 is the number of the experiment; column 2 the combination of circuits in use; column 3 the aggregate c. p. of these circuits; column 4 the observed distance of the photometer lamp; column 5 this distance corrected by the curve of Fig. 2, so that the "corrected distance" is the distance of a single lamp in the open, with point to diaphram, which gives equal illumination; column 6 is the illumination in c p./ft.² from this corrected distance; column 7, the calculated illumination, taken from the data of table I; column 8 the ratio of the observed to the calculated illumination, which is a measure of the reflected diffusion; column 9 the percentage that each combination of circuits is of the total measured illumination.

TABLE II.

No.	Lights Burning.	Candle Power.	Measured Distance. Inches.	Corrected Distance. Inches.	Illumination. Cp.÷ft.² Meas'd.	Illumination. Cp.÷ft.² Calc.	Ratio. Meas'd÷Calc.	Per cent. for Meas'd.
1	S+W+2D+L	30,784	25.00	22.50	4.54	2.90	1.57	100
2	S+W+1D+L	25,888	26.00	23.25	4.25	2.43	1.74	94
3	S+W +L	20,992	26.05	23.75	4.07	1.96	2.07	90
4	W+2D+L	24,000	28.00	25.00	3.68	2.13	1.73	81
5	W+1D+L	19,104	32.75	29.00	2.73	1.66	1.64	60
6	W +L	14,208	38.00	33.25	2.07	1.19	1.74	45
7	S +2D+L	18,112	32.50	28.75	2.78	1.80	1.54	61
8	S +1D+L	13,216	39.25	34.25	1.96	1.33	1.47	43
9	S +L	8,320	51.75	44.75	1.15	.86	1.34	25
10	2D+L	11,328	42.25	36.75	1.70	1.03	1.65	37
11	1D+L	6,432	57.50	49.50	.94	.56	1.68	21

The experiments of Table II give eleven equations for the determination of the four quantities S, W, D and L; these are reduced to four by using (4)+(5)+(6) as one; (7)+(8)+(9) as the second; (10)+(11) as the third and (1) as the fourth. Solving these four as simultaneous equations, the values of Table III are obtained for the separate sets of lights. Experiments (2) and (3) are omitted, as they do not agree at all with the others. Table III gives the value of 2D as 32 per cent. of the total, yet a comparison of experiments (1) and (3) shows that cutting off the dome when all the other lights are on makes a difference of only 10 per cent.; (2) similarly gives a difference of only 6 per cent., instead of 16.5 per cent. The other nine experiments are consistent; that is, the observed values of the different combinations agree with the sum of the values of the parts composing them. I have no explanation of the discrepancy of (2) and (3).

TABLE III.

Location.	Illumination. M's'd. Cp.÷ft.²	Illumination. Calc. Cp.÷ft.²	Ratio. M's'd÷Calc.	Per cent. M's'd.	Per cent. Calc.
S.	1.00	0.77	1.30	22	26
W.	1.87	1.10	1.72	41	38
2D.	1.42	.94	1.51	32	33
L.	.25	.09	2.80	5	3
Total	4.54	2.90	1.57	100	100

Table III shows that the "Star" lights are less reflected, as would be expected from their situation; the "Windows" have a higher ratio than the "Dome" and the "Lantern" the highest of all. The lantern dome throws all the light straight down. The average of the entire room is 1.57, as shown. The differences in the co-efficients are not great enough to change materially the relative effect of the different sets, as is shown by the last two columns of Table III.

The total illumination, 4.54 c. p./ft.², is very brilliant; the windows alone give a fair reading light on the floor, viz., 1.87 c. p./ft.². There are, of course, no shadows anywhere.

TABLE IV.

	c. p./ft.²	
Stars	4.75×10^{3}	per kilowatt
Windows	4.70×10^{3}	per kilowatt
Dome	4.67×10^{3}	per kilowatt
Lantern	5.55×10^{3}	per kilowatt

Table IV shows a rather unexpected result; it gives the illumination per kilowatt expended in the lamps, assuming 3.1 watts per c. p. It will be seen that in spite of the widely varying arrangement and positions of the different lamps, the illumination per kilowatt is practically constant for the three main circuits, and is but slightly higher for the "Lantern." It would hardly be thought that more light per kilowatt could be obtained by placing the lamps at a height of 135 feet from the floor. The table suggests the conclusion that with fair diffusing surfaces the location of the lights has little influence on their effectiveness in illuminating the given surface.

It is generally assumed that the total light intensity required to illuminate an enclosed space with broken surfaces is proportional to the volume of the space (Palaz). The floor area of the rotunda is 8,500 square feet, the volume 1,000,000 cubic feet, approximately; assuming 5×10^{3} as the average value of Table IV, it follows that the

Watts per cubic foot, per c. p./ft.² $= 2 \times 10^{-3}$.
C. p. per cubic foot, per c. p./ft.² $= 6.5 \times 10^{-3}$.
4.5 c. p./ft.² gives a brilliant illumination and requires
Per cubic foot, 9×10^{3} watts.
Per cubic foot, 2.9×10^{3} c p.

These tests were made under the direction of Mr. Bernard R. Greeen, the superintendent of the library.

MR. A. W. ZAHN, of St. Paul, Minn., says: "I have your data sheets and consider them of greater value than anything heretofore published in that line."

ST. PAUL, MINN.—The Gas Light Company has offered to furnish its 120 arcs now in use at the old price of $69.50, and to put in 85 more at about $84 per year each, displacing gas lamps.

DEVIL'S LAKE, N. D.—Mr. Allon Tompkins has a city contract and is putting in a plant which comprises one 40 k. w. generator and one 20 k. w. He is making purchases of poles, crossarms, wires, lamps, etc.

ELECTRICAL ENGINEERING IN EUROPE.—II.

BY DR. G. H. B. ZAHN.

EUROPE seems to be on the verge of a great development of the application of electricity to lighting, power transmission and street railway work. Competition, however, among the large manufacturing companies has become very keen and resulted not only in the design and construction of

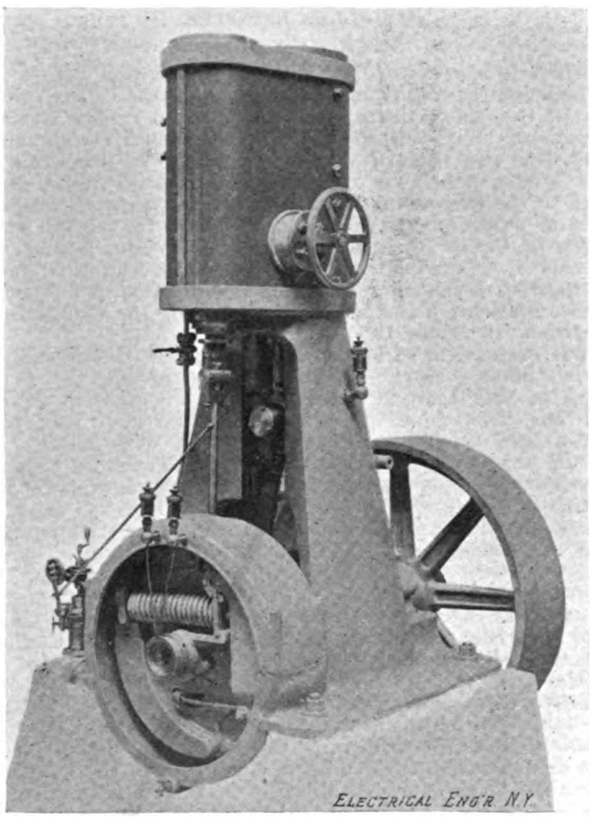

FIG. 1.—250-H. P. GERMAN AUTOMATIC CUT-OFF ENGINE.

superior dynamo-electric machines, but has also brought out new types of high speed automatic cut-off engines, which are cheaper than the slow speed, valve gear engines and permit of running direct connected dynamos at a speed that must be considered the most advantageous in regard to both economy and weight, that is, price of the generating set.

It may, therefore, be interesting for American engineers to

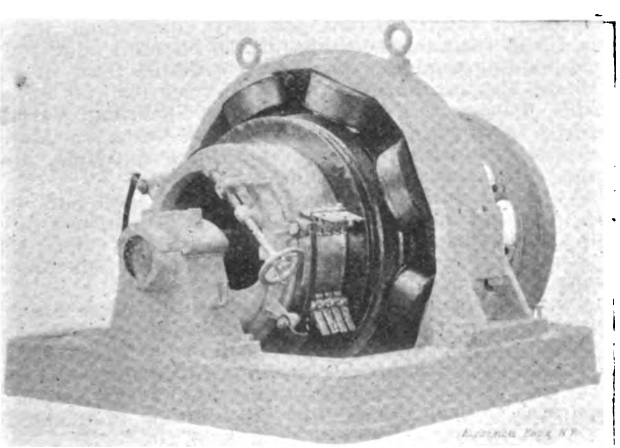

FIG. 3.—GERMAN DYNAMO.

compare continental machines with American types, and this the author proposes to do in these articles:

1. ENGINES AND DYNAMOS OF THE BERLIN MASCHINENBAU ACTIEN GESELLSCHAFT.

Among the machines ranking foremost at the Berlin Exposition of 1896 were the steam dynamos of the Berliner Maschinenbau Aktiengesellschaft, successors to L. Schwartzkopff, of Berlin, Germany. The dynamos have since then been still more improved and at present represent the highest standard of excellence in both mechanical and electrical design and construction. The B. M. A. G. are building steam engines of various types from the simple slide valve engine, controlled by a throttling governor, to the highest grade triple expansion condensing engine, and in sizes ranging from 1 to 2,000 h. p.

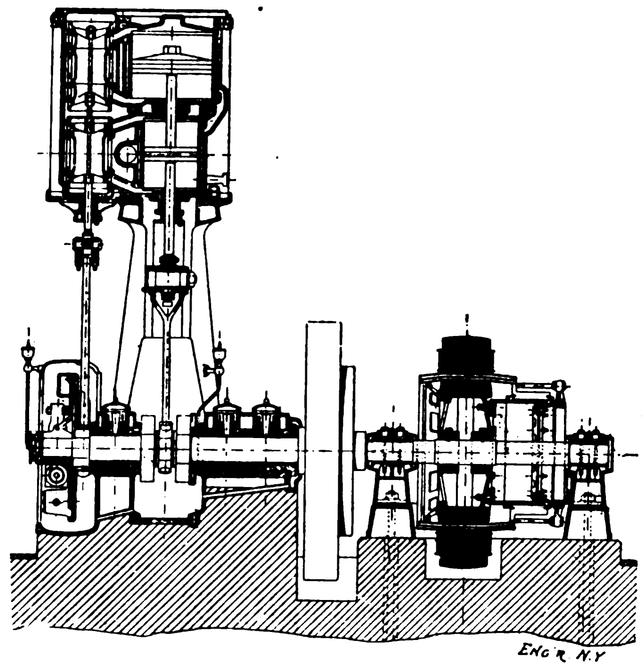

FIG. 2.—250-H. P. ENGINE AND DIRECT CONNECTED DYNAMO. SECTION.

In order to meet the rapidly growing demand for a simple and efficient high speed engine that would be especially adapted to electrical work the company undertook the manufacture of an engine which has become favorably known throughout Europe and is already in successful operation in a great number of electric light and power plants.

Fig. 1 shows a general view of a "Tosi" tandem compound engine, as manufactured by the B. M. A. G. It can be easily seen that in designing this engine the importance of proper degree and distribution of strength and weight, simplicity of arrangement and due regard for symmetry of form has been carefully kept in view.

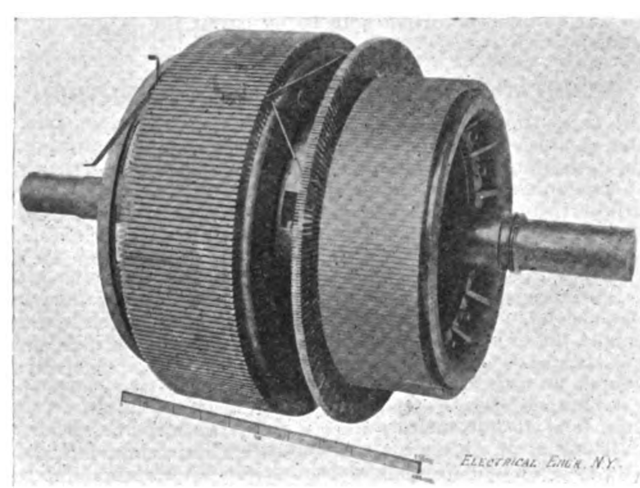

FIG. 4.—ARMATURE UNWOUND.

A sectional view, Fig. 2, including a dynamo, gives an idea of the simplicity and the arrangement of the working parts. The engraving shows every detail of the engine, and a lengthy description of the different parts, therefore, need not be given. Special attention, however, may be called to the excellent arrangement of the balanced valves, both controlled by the

very simple and sensitive shaft governor, to the small clearances, and the very small receiver room between the high and low pressure cylinders. The vertical position of the engine prevents a wearing down of the cylinders and valve chests, and has the further great advantage that the whole generating set takes only about from one-half to one-third of the space occupied by a similar horizontal engine. An automatic oil pump supplies the oil to all parts needing lubrication, and oil cups are therefore entirely done away with.

The engines are extremely well balanced and run perfectly noiselessly and without the least vibration. They are built in different types; single cylinder standard and marine type, and tandem compound standard and marine type. The output ranges from 7 to 400 h. p. and the speed from 500 to 220 r. p. m. The steam consumption—at 150 pounds boiler pressure—of the large sizes is guaranteed to be as low as 17.5 pounds per ind. h. p. per hour, while the smallest single cylinder engine exhausting into the open air and running at about 500 r. p. m., uses 38.5 pounds of steam per h. p. per hour.

The company's smallest triple expansion engine, rated at about 85 h. p. at 225 r. p. m. has a guaranteed steam consumption of 14.25 pounds per ind. h. p. per hour, and larger engines show a still better result (11.9 pounds of steam.)

One of the B. M. A. G. multipolar 150 k. w. generators running at a speed of 240 r. p. m., is shown in Fig. 3. While a great many German manufacturers of electrical machinery still adhere to the use of cast iron magnet frames the B. M. A. G., in their machines, use cast steel exclusively. The output of the dynamo is thus greatly increased and the weight can be reduced about 25 per cent.

The construction of the magnet system and of the armature core does not differ materially from the design of prominent American manufacturers; the winding of the armature, however, shows some marked improvements. The armature conductors of multipolar dynamos are, as is well known, generally arranged in either parallel or series grouping. If in the former case the brush sets are cross connected, there are just as many brush sets as poles; cross connection of the conductors, so as to obtain only two sets of brushes, is difficult to accomplish and not often used. In the latter case, that is, series grouping of the armature windings, only two brush sets are required, such being the usual arrangement. In the B. M. A. G. multipolar dynamos a special series grouping is employed, allowing the use of two or a greater (but even) number of brush sets. This arrangement is of the greatest advantage, especially on large machines, since the brushes may be placed in such a position that they are neither on the top nor on the under side of the commutator. As the upper and lower brushes of large dynamos are not easy of access and are therefore generally neglected, the armature winding of the B. M. A. G. must be considered a valuable feature of their machines. With this special series grouping all the advantages of the usual series grouping are obtained, that is, the difference of strength of the various magnetic circuits does not affect the good working of the dynamo and does not cause a decrease of the efficiency, as is generally the case with dynamos having the armature conductors cross connected or grouped in parallel and the number of brush sets to be cared for is greatly reduced.

RESISTANCE OF SALT SOLUTIONS IN MOTION.

Dr. Italo Bosi contributes to the "Nuovo Cimento," 4, v. a series of observations on the electric resistance of solutions of salts in motion, which have an important bearing on Hittorff's and Arrhenius' theories of electrolysis. Dr. Bosi finds that in solutions where the effect of electrolysis is to produce greater concentration at the positive pole, the resistance increases when the liquid is moving in the opposite direction to the current, and decreases when it is moving in the same direction: but the increase in the first case is greater than the decrease in the second. Where the concentration is greater at the negative pole the effect is reversed; the increase of resistance, however, still exceeds the decrease. Finally, when electrolysis produces no difference of concentration at the two electrodes, the resistance is unaffected by the motion of the liquid. These conclusions do not entirely accord with the hypotheses either of Hittorff or of Arrhenius. An investigation somewhat allied to the present had previously been made by Edlund, but this was rather qualitative than quantitative in character, and, moreover, the fluids used by Edlund (town water, alcohol and water, and others) left some doubt as to the nature of the dissolved salts contained in them.

BOSTON—In the recent article on the subway, it should be added that the track work was installed by General Roadmaster M. R. Hapgood, of the West End Railway, under the direction of the civil engineer, Mr. A. L. Plimpton.

MUNICIPAL AFFAIRS

COST OF SERVICE TO USERS AND TAXPAYERS.[1]

BY ALLEN R. FOOTE.

INTRODUCTION.

I WISH to say a word by way of explanation before commencing reading from this paper. The title I have taken is "Cost of Service to Users and Taxpayers—a Proper Basis for Comparisons Between Private and Municipal Ownership of Water, Gas and Electric Lighting Works." In preparing this paper I have gone over the subject as I have found it discussed in the proceedings of the American Economic Association, and in the proceedings of a national convention of the officials of Labor Bureaus, in which thirty-four States were represented, where I find a movement was originated for an investigation of this subject, which is now being conducted, or preparation being made for conducting it by the United States Department of Labor.

I have prepared a pamphlet of 88 pages. In the appendix of this pamphlet I have quoted from the authorities I have named, so that I might bring together a statement showing what has been done, the difficulties that have been found and the lines on which the investigation is to be made. You will find that I have quoted here in this appendix from the American Economic Association—from a monograph by Prof. Edmund J. James, of the Pennsylvania University; also from Prof. Henry C. Adams, chairman, University of Michigan, Ann Arbor, and statistician to the United States Interstate Commission; Prof. George W. Knight, Ohio State University; Prof. Edward W. Bemis, Professor of Political Economy of the Kansas College of Agriculture, formerly of the Vanderbilt University of Nashville, Tenn.; Mr. M. N. Baker, editor of "Engineering News," of New York City; Prof. Walter F. Wilcox, of Cornell University, Professor of Economy; Mr. Osborn Howes, journalist, of Boston Mass., editor of the "Boston Herald;" Hon. James W. Latta, Secretary of Internal Affairs of Pennsylvania, and ex-officio head of the Bureau of Industrial Statistics of that State; Prof. John R. Commons, of the University of Syracuse, New York; Hon. F. E. Barker, chairman of the Board of Gas and Electric Light Commissioners of the State of Massachusetts; Mr. John S. Clarks, treasurer of the American Statistical Association; Hon. S. B. Horne, Commissioner of the Bureau of Labor, of Illinois; Hon. Lee Meriwether, Commissioner of Bureau of Labor, State of Missouri; Mr. John T. McDonough, Commissioner of the Bureau of Labor, State of New York; Hon. George A. Schilling, Commissioner of the Bureau of Labor, State of Indiana, and Edward M. Grout, of Brooklyn, of the Association of the Public Control of Franchises, of New York. Then, when I ran out of authority, I wrote a little authority of my own, and quoted from some of my former writings.

The text of this talk, that you may understand its full scope, I will read the headings of the chapters that I wish to omit reading to-night. They are: Variable Basis of Price for Water Service; Variable Basis of Price for Gas Service; Variable Basis of Price for Electric Service; Variables caused by Local Conditions; Statements of Costs, Variables in Legislative Conditions; Secrecy of Private Accounts, and a Change of System Recommended.

I have printed only a couple of hundred of these pamphlets, which in proof form I would be pleased to present to any who wants them. I hope to find in some way which I don't know now a means of having a copy of this pamphlet sent to every councilman and mayor in the United States.

You will see when you look this through that after taking up the investigation of the difficulties in the way, that I take here the position which I took in 1890 before the American Economic Association, that the discussion of theories was of no further use: that the practical thing was to agree upon our statistics as to cost and method of obtaining that, and then submit our theories to the test of facts.

I think the people of this country can do themselves no better service than to join hands in promoting an investigation, and pending investigation to suspend judgment for one year until they can have the facts before them.

THE cost of service to users and taxpayers is the only proper basis for comparisons to show the relative economic advantages derived from private and municipal ownership and operation of water, gas and electric lighting works.

[1]Read before the League of American Municipalities, Sept., 1897.

In 1888 it was reported that there were in the United States 544 municipal water works, 5 municipal gas works, no municipal electric lighting works, and no municipal street railways. It is estimated that in 1897 there are in the United States 1,900 municipal water works, 25 municipal gas works, 400 municipal electric lighting works and no municipal street railways.

No question pertaining to municipal policy or to the efficiency of municipal government has caused so much discussion or is of greater economic importance for the welfare of every municipality, and of all the people, than the question of the ownership and proper regulation of municipal public service industries. While ownership and operation may be intrusted to private corporations, regulation must always be a governmental function.

Those who study questions of public policy, solely for the purpose of discovering ethical and economic principles, which if correctly understood and applied, will most surely result in practical benefits for all the people, recognize the question of properly controlling, without unnecessarily checking the growth of corporate power, as the most difficult and the most important problem now demanding a wise solution. They see many dangers for public and private welfare when purely economic questions are made political issues without the guidance of facts. There has been ten years of discussion, investigations and studies without number, by teachers of political economy, committees of economic associations and municipal reform associations for the purpose of fitting theory to practice; and by committees of municipal councils for the practical purpose of determining a just price to be paid for water, gas, or electric lighting service; or to determine whether it would be wise for the municipality to assume the ownership and operation of the industry for its own account. The vital question, "How can the power of concentrated organizations be utilized to its fullest expression, without risk of suffering from its real or imaginary tyranny," is still unsolved. In attempting to solve this question it must be clearly seen that the interest of one consumer, whether an individual or a municipality, is identical with the interest of all the people, and that the distrust with which monopolies are universally regarded, is developed by the fact that the people have been taught to rely upon the regulative force of free competition, to guarantee that services will be rendered at the lowest possible cost. These natural monopolies are industrial organizations, superior to the regulating influence of competition. Society will not render humanity its best services until it discovers some principle for the guidance of legislation in controlling these industries from which all elements of competition are eliminated.

It is in the mind of every man that something is wrong somewhere, but just what is wrong, or where it is wrong, or why, he does not appear to know. In the absence of facts any charge is safe. The greed of corporations, exacting burdensome tribute to pay dividends on watered stock, or interest on bonds covering twice over the necessary cost of construction and equipment, excites the imagination of some; while others center their attention on "boodlers" in city councils and State Legislatures, who are always out for bribes whenever any legislation is required for public service monopolies. To restore the people to a normal condition of mind, in which they will guide their action by a knowledge of the facts—not by fear, prejudice or superstition—appeal is made to statistics by all parties to the controversy as a means of correcting abuses by and of corporations, industrial and political.

The statistics needed have never been gathered. Those who have undertaken to collect them have been discouraged by the work and expense involved, and the practical difficulties met with in attempting to get facts sufficiently comprehensive and reliable for safe generalization. Careful investigators, whose only care is for the truth, know what a faint light the statistics they have been able to gather throw upon the question of the comparative efficiency of public and private ownership and operation of public service industries.

Less accurate, less cautious persons have, however, taken partial data, collected almost at random, and without opportunity or ability to verify their correctness, and deluded the people to their injury with incorrect theories, based on incomplete statements. To base a general report for the United States upon the study of a score of cities is absurd.

Professor Bemis declared in 1891: Never before has the desire for accurate facts and principles in regard to city ownership of gas works in this country been as great as now. In 1896 he declared: Surely the only alternative to public ownership is the fullest publicity as a basis for wise public regulation and that no private investigation (of which he has made many) can take the place of a public one. He says in the "New Time" for August, 1897: "In our social problems what the country needs is accurate information and a thorougly comprehensive grasp of the situation."

Few, if any, subjects of equal importance seem to be so lacking in reliable and detailed data. Still, the most competent observers declare that if it can be shown that municipal industrial services can be supplied more cheaply and economically through private enterprise than under the municipalities, no one will be disposed to question that line of policy. What every one wants is to get the best service at a reasonable cost.

Without a presumption for or against the policy of municipal or private ownership and operation of public service industries, the United States Department of Labor has undertaken a complete and thorough statistical investigation of the cost of services rendered by water, gas and electric lighting works. In announcing his purpose to do this, at the Twelfth Annual Convention of the National Association of Officials of Bureaus of Labor Statistics, Hon. Carroll D. Wright, United States Commissioner of Labor, said:

"The theory of statistics which actuated the committee (in considering the subject of this investigation) was not whether municipal ownership was desirable, but whether an investigation could be instituted which would enable municipalities and the citizens thereof to determine whether there was any advantage to the consumers in such ownership, or whether, on account of the cost, they should continue in the old way. It is purely a question of business. * * * We will have an investigation which will cover every one of the States and Territories of the United States, thus giving the public a complete statement of the extent to which municipal ownership has been carried in this country. * * * It is our duty to our constituents everywhere to see to it that they may be informed on this great question which is being agitated more and more every year, and informed with all the accuracy that it is possible to put into the information. Every man in the United States, whether he believes in municipal ownership or whether he opposes it, will welcome this investigation in the warmest way."

Every mayor of a municipality, every member of a city council, every Governor and every member of a State Legislature, in fact all of the people, can unite in desiring the complete success of this impartial and authoritative investigation.

The past claims our attention by reason of its ability to furnish trustworthy guidance for future action. It is the consensus of opinion of all who have given earnest and intelligent attention to the subject, and who have had experience with it, that reliable, comprehensive statistics—the only kind of data that can be of service—cannot be obtained by correspondence. They can be had only by expert personal solicitation, and even then it is feared that in a large portion of instances the essential facts will be difficult or impossible to ascertain.

The most serious obstacles in the way of securing statistics sufficiently comprehensive and reliable for safe and fair comparisons are to be found in the multiplicity of variables in the basis for prices for services, and statements of cost, largely caused by a regrettable want of uniformity in systems of accounting. There will be many inquiries essential to a correct result which cannot be answered from records of accounts as kept, the information for which can only be given by making carefully considered estimates.

Prices quoted without any specifications to show what is delivered for the price, and unaccompanied by a clear statement of all local conditions necessary properly to explain the price, are not a reliable basis for comparisons. Prices so quoted have been the means of disseminating more misinformation, and doing more injustice than any other feature of the discussion of the subject of a correct public policy regarding public service. It is fundamentally necessary that every factor essential to show what a user, or a taxpayer gets for the price he pays, and why the price charged is reasonable, shall be included in the questions asked to obtain the information upon which a report is to be founded. If this is completely and faithfully done, investigation will be of great service to the people, and its full value cannot be easily computed. That the investigation may be thorough, quickly made and fully reported, it is desirable that its scope, methods and purpose shall be cordially approved by those best able to judge of its essential character.

Meter rates are based on quantity consumed. All other systems of charging are based upon estimates. Schedules based on estimates are formulated on widely different plans, such as the number of fixtures, rooms, or persons in the house; or the height of the house, the number of feet front of the lot it occupies, or the purposes for which water is used. All such schedules are of necessity more or less inaccurate and work unevenly, requiring consumers under certain conditions to pay but little and under other conditions to pay exorbitantly for the water they use. While the supplying of the water is, in comparison with gas or electrical service, an exceedingly simple undertaking, the methods of charging for the service

present so many variables it has been impossible to find any common unit or basis for price. Within six weeks the officer in charge of the Water Department of Washington, D. C., indorsed the complaint of a water user regarding the method of rating houses for water rent by the number of feet front and stories high, with the statement that "it would be inadvisable to make a change unless it was positively a certainty that a more uniform scale of rates could be devised, and of this there is no evidence whatever."

In some cities water in its natural condition is delivered to consumers; in others it is purified. In some the source of supply is near at hand, so located that it is delivered by gravity, and so abundant that no storage is required. In others the source of supply is distant, so located that it must be pumped or raised to standpipes or tanks, and so liable to scarcity that it has to be stored. In some cities it is the policy to derive only sufficient income from the water works to pay operating expenses, leaving principal and interest on bonded debt and all fixed charges to be paid by taxation. In others the policy is to make the income pay for the works, principal and interest, and to cover all fixed charges and operating expenses, thus placing on water consumers, by indirect tax, the cost of all water used for fire protection, street cleaning and other public purposes. The effect of all these variables is to render a statistical comparison of cost to users and taxpayers for water service in the different cities one of the most difficult features in this investigation. In the light of this fact it is seen how unjust comparisons of prices for water service frequently are, as usually made, and why. The householders, the merchants, and the manufacturers of a city are misinformed by being furnished with quotations of prices in other cities which give no explanations to account for apparent differences. The prices owners of private water works are permitted to charge are forced nearly to the cost of the service by the statement that prices in municipalities where the works are owned and operated by the city are very much less, no showing being made of the amount the taxpayer is required to contribute to make good the deficiency caused by the low price. One good result from this investigation may be to promote the use of water meters, or to establish some basis for contract prices that will admit of uniform schedules and comparisons.

In the gas business there is an established unit for output and price which greatly simplifies the problem of how to obtain data for equitable statistical comparisons. The variables are found in quality of gas furnished, area over which it is distributed and aggregate consumption. Units, such as the ton of coal, the chaldron of coke and the barrel of tar, differ widely in different localities. A ton of coal might seem to be a unit of precision, but it varies in different works nearly 12 per cent. In some States the reckoning is not by the ton, but by the bushel. In spite of these facts, prices charged in one place are used without explanation to influence the price charged in other places, always to reduce, but never to increase it. The facility with which such misinformation is spread over the country brings all municipalities into one vast trust to secure through reflected effort what they cannot gain in isolation. The councilman who votes for a price for gas in excess of the lowest price of any of his constituents may have heard of as being charged elsewhere must be prepared to meet the charge of being a "boodler," and to answer insinuating questions. Misinformation breeds discontent, suspicions and prejudices which otherwise would find no lodgment in the minds of the people.

Electrical services are charged for by meter and by contract rates. The meter units are ampere, watt and kilowatt hours. Electricity, unlike water or gas, cannot be stored for future use in a reservoir or holder. Some attempts are made to utilize storage batteries in this behalf, but their use is not sufficiently general to influence results for the business when considered in its entirety. The most difficult problem for the manager of an electrical plant is to find full employment for it during all the hours any part of the service he is required to perform makes it necessary to keep it in operation. For this reason meter rates alone are not a reliable basis for comparisons, as the rate given is influenced by the hours of service. This observation holds good also in contract rates for lighting and motor service. The price per lamp is based upon the current consumed by the lamp, the number of lamps installed for the use of one customer, the number of months or years for which the contract is made, and the hours of service given per lamp per day, month or year. To say that the price per arc lamp in a certain city is so much per hour, night, month or year, is absolutely meaningless as a basis of statistical comparison. A statement of price which does not show what is delivered for the price, has no statistical value. In prices charged for motor service, variables are found, principal among which are the purposes for which motors are used. Occupations requiring a motor of small capacity to run continuously, will consume much more energy than other occupations requiring a motor of large capacity operated intermittently. In such cases a uniform charge per horse power for the motor installed would be unjust. The basis of the charge, under a contract rate must be the use of the motor rather than its capacity.

An important factor affecting price is found in the character of the construction of the distributing system. In densely populated cities where the service lines are placed underground, the cost of the system is very much greater than in small towns where few structures make a pole line an attraction. This variable is sometimes complicated by a requirement that compels the lighting company to hire ducts from a subway company, or the municipality, at an annual cost which perceptibly increases the cost of the lighting service.

In addition to the many variables due to the technicalities and methods of each industry, are the variables caused by local conditions which affect all of the services in the same general direction. The cost of power, whether water or steam, is an important variable. In the case of steam the variable is based on cost of fuel and water. Other variables are: Density of population, or the concentration of business in relation to area; character of subsoil, affecting cost of underground construction; character of climate, affecting cost of operation and maintenance; taxation in all forms; and interest on investments affected by the soundness and stability of public policy. To make a reliable statistical comparison of prices, the influence of all these factors on price must be shown, or at least, the variables must be stated in a way to explain the reasonableness of variations in price.

When an industry is owned and operated by a private corporation the cost of the service to users and taxpayers is limited and fully included in the price paid for it. Users and taxpayers as such, are not interested in the details of cost of construction, general expenses, fixed charges, operating expenses, and maintenance. Their interest begins and ends in all considerations which explain the price they pay for the service and furnish a basis for establishing the reasonableness of the price. The people are right in demanding that services shall be rendered in the best manner known that has been made commercially practicable, and at the lowest fairly profitable price. In determining these points the representatives of the people, whether mayors of municipalities or members of city councils, Governors of States, or members of Legislatures, can have no better guide than the facts of experience. That experience may be available and authoritative the facts developed under it must be collected, tabulated and reported by an expert, impartial and all comprehensive authority that can reach every corporation and every municipality in the whole country through its duly commissioned agents. It must make a personal investigation of all facts relating to prices charged, and of all conditions necessary to explain such prices. The results of such an investigation will guide judgment to a correct conclusion.

In every case, whether a service is rendered by a private corporation or by a municipality, the private user is interested directly only in the price charged for it. In the case of municipal ownership and operation, however, he is also interested in the cost of production, as this will affect his taxes. The consideration offered for his vote in favor of municipal ownership is that the cost of the service will thereby be reduced, and that this reduction will become effectual in the price he is required to pay for what he gets. The struggle for municipal ownership and operation is a struggle to depress the cost of rendering services, not to raise prices for services rendered.

This is the meaning of the agitation for the municipal ownership and operation of public service industries that has taken place in almost every city and town in the United States within the last ten years, and it is now rapidly reaching an acute stage of development through being made a political issue. Professor James says: To continue the farce of allowing competition to regulate prices simply means that good and cheap gas is forever impossible. Professor Bemis says: The financial benefits to the community are in the shape of cheaper gas, or more revenue to the municipality. It is to be hoped that cities may be enabled to dispense with the present necessity, for revenue purposes, of charging more than cost for gas. The "Association for the Public Control of Franchises" of the City of New York says: What is even more important to the mass of citizens, public control of the means of transportation and illumination will lead to a similar reduction (one-half) in car fares and gas bills. Edward M. Grout says: The question * * * touches the pocket of every gas user to the extent of from 20 to 40 per cent of his gas bills.

When a service is rendered by a private corporation for the public purposes of a municipality, the price paid by the municipality limits its cost to taxpayers. When the same service is

rendered by the municipality for its own account, through the ownership and operation of the industry, the price to taxpayers is the entire net cost of the service.

The "Association for the Public Control of Franchises" of the City of New York says: "According to the most conservative authorities, half the city's revenues could be derived from its street car, gas and other franchises. In this event taxes upon private and personal property would be cut in two." Statements similar to this cover the consideration invariably relied upon to secure votes for the approval of proposals authorizing the construction and operation of municipal works for rendering industrial public service. Every mayor and every member of a city council, every Governor and every member of a State Legislature, where such a measure has been discussed is familiar with the representations made to show the economic advantages expected to result, for the benefit of private users and taxpayers, from the adoption of the policy of municipal ownership and operation.

In the case of services rendered by private corporations, price is cost to users and taxpayers. In the case of services rendered by municipalities, cost is price to taxpayers, and price charged is cost to private users. These facts are established by the conditions of the undertakings, beyond the power of intelligent controversy, or change by legislative enactment. To determine the relative economic advantages derived from private or municipal ownership and operation of public service industries the price charged by private corporations and the cost of service to users and taxpayers is the only correct basis for comparisons. Price charged by private corporations can be ascertained. To ascertain the cost under municipal ownership and operation this investigation must include every item of cost involved in the rendering of the service. The facts needed should all be matters of public record. Assurance is given that they can be obtained. This will give opportunity to the municipal representatives of the people, wherever municipal works are owned and operated, to demonstrate the efficiency of their administration of the people's business. It will afford an opportunity to prove the affirmation of Professor James when he says: "The common argument against the public management that it is necessarily more expensive than private management, is not well grounded either in reason or in fact." It is an opportunity to add the authority of experience to the inference made by Professor Bemis when he says: "The argument that cities can manage gas works successfully because they have succeeded with water works has been frequently made, and has force."

This investigation by the Department of Labor is entered upon with a full knowledge of its vital importance to all urban citizens, to all municipalities, and to all of the vast investments held in public service corporations. If it shall show that price to users and taxpayers, charged by private corporations is unreasonably higher than cost under municipal ownership and operation—what advocate of municipal ownership believes it is not?—private corporations will have no choice but to reduce their prices or to sell out to the municipalities in which they are located. To this final crucial test private corporations must submit. This test will bring the struggle to depress cost of rendering municipal industrial services to an acute stage of development. It substitutes actual competition between private corporations and municipalities, for competition between corporations within municipalities. The only difficulty in the way of making this test accurate, is the want of uniformity in methods of municipal bookkeeping. In measuring the prices charged by private corporations against cost of production by municipally owned and operated works, justice and the interests of the people, demand that all factors of cost shall be correctly and fully included in the accounts. An under-statement of costs will be unjust to vast vested interests, and will lead the people into drawing erroneous and harmful conclusions.

When a person buys an article, quality, quantity and price are all his interests require him to consider, but when he contemplates undertaking the manufacture of an article, every item of cost as well as selling price becomes of vital importance to him. In comparing price with cost, this investigation will decide for the people of many municipalities a grave question of public policy; whether they will continue to buy the services they need from private corporations or undertake to manufacture them for themselves. In this aspect of the question the accounts of every municipally owned and operated works for the supply of industrial public services becomes of national importance and should be exhibited with absolute correctness.

In the discussions preliminary to deciding upon this investigation Professor Wilcox drew attention to the fact that the accounts of private corporations or of municipalities are not kept by "any approximately common method." Mr. Baker suggested that the vagaries of bookkeeping make comparisons almost impossible. Mr. Howes gave a word of caution against a disposition to understate cost of construction. Mr. Barker stated: A uniform system of accounting is of the highest importance in statistical work. It may be doubted whether reliable statistics are possible without it. There is, according to my own observation, great lack of uniformity, not only throughout the country at large, but within the limits of a single State. The fact that business has come to be much less profitable than formerly has imposed upon managers a desire to compare among themselves reliable data, and to this end to seek uniformity of accounts and records, so that the present tendency is strongly in that direction.

In 1890, when Professor Adams read a paper before the American Economic Association under the title of "Statistics as a Means of Correcting Corporate Abuses," the attention of the Association was directed to the vital importance of a uniform method of determining cost. All professors of political economy, all writers and speakers of every school of thought who have to do with creating, guiding and applying public opinion to the affairs of the people are obliged by the nature of this subject to appeal to statements of cost to establish their theories or to justify their action. This convention can do no wiser thing than to invite the American Economic Association to formulate a system of accounting for all municipal affairs that will make reliable comparisons practicable, and will show accurately all factors of cost.

Although uniformity in accounting does not exist, it is believed, by the use of schedules designed properly to classify and include all factors of cost, statistics can be collected that will form a basis for reliable comparisons. The general divisions of these schedules would be:

1. Cost of works. 2. General expenses. 3. Fixed charges. 4. Operating or manufacturing expenses. 5. Maintenance.

Appropriate subdivisions would be made under each general heading. By carefully apportioning the total of each general division to the several items included in it, a result could be reached from the accounts of any public service industry, whether owned and operated by a private corporation or by a municipality, that would be a true statement of cost, and furnish a reliable basis for comparison. By using the same schedule for private corporations and for municipalities, and basing all calculations on the cost of the works, the disturbing factors of "watered stock" on one hand and "official corruption" on the other hand, will be entirely eliminated from the problem. Interest, taxes, and depreciation will be calculated on the same basis in every instance, and all other items of cost would be investigated on corresponding lines for private and public management.

If there be a factor of error in this method of conducting this investigation it would be against private and in favor of municipal ownership. Interest will be computed on the cost of the works in all cases—no regard being paid to how they might be capitalized or bonded in the case of a private corporation—at the rate per cent. paid by the municipality on its public debt. The conservatism of this course is unquestioned. Professor Bemis says: The bonds of a public plant usually bear a lower rate of interest than those of a private company. Mr. Edward M. Grout says: The situations of these cities (referring to several cases of municipally owned and operated works) are too diverse, the savings to the public are too great to enable us to explain away these results by any differences in the price of labor or coal. The results are due chiefly to the fact that cities can borrow money about 3 per cent. cheaper than private corporations, and to the additional fact that cities do not attempt to "water" the capital employed, nor to pay dividends upon fictitious capital, or capital which has been used up and consumed a generation ago, and which ought to have been long ago charged off to depreciation.

Taxes paid by private corporations would be offset by including in the municipal statement an amount equal to the taxes that would be collected from the business if owned by a private corporation.

Depreciation would be calculated at the same rates per cent. in both cases. Professor Bemis says: "Taxes must be included in municipal accounts in comparing with private companies. * * * It must be borne in mind, however, that a plant belonging to taxpayers may let depreciation rest in the hands of the consumer, where it can be put to more profitable use until such time as it may be needed, when it can be raised by taxation."

It should be clear to any mind that a result of operation which must ultimately be paid for by taxation is a part of the cost of operation and should be charged into the cost for the year covered by any statement of cost. Mr. Howes says: In electricity particularly, invention, constantly changing conditions, uncertain and varying systems of maintenance and constant improvements, makes depreciation very large. Mr. Barker says: Depreciation is a part of the cost of operation,

as much as either coal or labor. It should include deterioration due to use, reduction in market price of apparatus, which becomes commercially useless through the progress of the art, and the displacement of appliances, not worn out, but displaced on account of the growth of the business, making reconstruction and rearrangements of the works necessary. Mr. Edward M. Grout says: Everything is included in them (referring to accounts of municipally owned and operated works in England), * * * Interest on investment, taxes, insurance, depreciation, repairs and betterments, all operating expenses (including good wages and salaries), a sinking fund and a reserve fund, all are charged before net profits are reckoned."

The cost shown on the schedules of the United States Department of Labor for municipally owned and operated works, will be arrived at exactly as it would be for private corporations. The comparisons would be cost of construction with cost of construction; interest with interest; taxes with taxes; depreciation with depreciation, all computed on the same basis and at the same rates per cent., and all other costs, item for item.

Some factors of high potency, influencing the price charged users and taxpayers for services rendered by private corporations never appear in the cost price of services rendered by municipalities. They may be grouped under the general term of Legislative Conditions. They are met with at every point of contact between private corporations and State or municipal authorities, users and taxpayers, from the obtaining of a company's charter or certificate of incorporation to the collection of payments for the services it may have rendered.

Under the most favorable circumstances there will be many occasions for honest differences of opinion between corporation managers and the elected guardians of the people's interests, when they are dealt with in a spirit of fairness and just appreciation. But when the minds of the people are prejudiced by insinuations and unproven statements, which make the advocacy of measures designed to "down monopoly" popular, conditions are created which lead to the loading with onerous requirements of every contract privilege it is necessary for corporations to negotiate for or obtain from municipal councils and officials. Municipal being political corporations have none of these conditions to contend with, none of the uncertainties caused by them to include and provide for in the factors of risks assumed in undertaking the business. Their property is recognized as public property and goes untaxed by municipality, county or State. The municipal government has absolute control over the requirements for placing structures on, over or under the streets; opening, repairing, cleaning and sprinkling strets; the regulations necessary for the proper and efficient rendering of any public service; requirements for its quality, quantity and price; specifications regarding methods of production, distribution and location of lines of service; the motive power that may be used; the exclusion of competition; the division of the territory to be served, whether there shall be but one organization for the whole municipality, or several; and the period of time during which the works may be operated. When the municipality owns and operates the works no one supposes for a moment that it can make a gain by inflicting penalties, raising obstructions, or stipulating unnecessary, unscientific, uneconomic requirements for their construction and operation. No one advocates the raiding of the territory supplied by municipal works by another municipal works, or of dividing the business of a municipality between two or more unrelated municipal works as a means of reducing the cost of the service. No one intimates that municipal works should be constructed on approval by limiting the right of the municipality to own and operate them to a specified term of years twenty, thirty or fifty. No one requires a municipality to terminate its public lighting service every one, three, five or ten years, and then to make an exhibit of the cost price of the service, its continuation to be determined by the acceptance of a bid, in the securing of which proposals may have been invited from all competitors, some of whom may make a bid less than the cost of the service, for the purpose of getting access to the business places and homes of the people, relying on recovering from private users all that is lost on the public contract, with a surplus for its profit. The advocates of municipal ownership place a high value on franchise conditions. They hold a franchise, such as a municipality necessarily assumes for itself when it undertakes the ownership and operation of a public industrial service—which is all inclusive, exclusive, perpetual and untaxed—at a value higher than anything else within the control of a municipal council or of a State Legislature. For nothing else within the sphere of legislative action are members of municipal councils and State Legislatures blamed so severely, and held up to public scorn and condemnation with so much indignation as for the so-called "giving away of franchises." The values placed on franchises by indignant champions of the rights of the people are never included in investments or fixed charges as a part of the cost of municipal ownership and operation.

No one can better estimate the influence of all the factors of cost and uncertainty included in this group of "legislative conditions" than the practical business men who are charged with the responsibility of legislating for and administering municipal affairs. Whatever value they, or the advocates of municipal ownership and operation, may attach to these conditions should be added to the cost price of municipal services to be shown in the report of the investigation by the United States Department of Labor. These intangible values cannot be determined by statistical methods, but they are as much a part of the cost of the service, and must be taken into consideration to explain prices charged by corporations, as the cost of coal or labor, to make comparisons equitable and fair between price cost to users and taxpayers for services rendered by private corporations, and the cost price of the same services when rendered by municipalities.

There is an eminently practical way in which the true value of these legislative conditions can be ascertained and utilized for the benefit of all the people. It can be accomplished by making legislative conditions for private corporations and for municipalities identical, under a contract requiring the fixing of prices charged by private corporations at rates calculated to yield only sufficient income fully to pay all general expenses, fixed charges, including interest on the investments, taxation and depreciation, operating or manufacturing expenses, the cost of maintenance and a reasonable profit, say 10 per cent. Such a contract will realize for the people the full value of the economic legislation suggested by Professor Adams when he says: "It should be the purpose of all laws touching matters of business to maintain the beneficent results of competitive action while guarding society from the evil consequences of unrestrained competition."

The investigation of water, gas and electric lighting works now undertaken by the United States Department of Labor on the lines herein indicated will result in the publication of statistics that will serve as a reliable and just basis for comparison between price and cost of services to users and taxpayers, when rendered by private corporations and municipalities. It will supply a reliable and just basis for comparisons between the prices charged by private corporations or between the cost of service rendered by municipalities, and it will accompany these statements with explanations that will enable members of city councils, municipal officers, users of the services and taxpayers, to form a correct opinion regarding the reasonableness of the price, of the cost of the service in their own municipality.

Assurance is given by Professor Bemis that "when the real success thus far of city ownership in this country is once generally known, a rapid increase in the number of such works is sure to come, and that a thorough publicity can be given to the facts guarding municipal monopolies."

In 1888 Professor Henry C. Adams called attention to the fact that "there is no need to discuss this question as something wholly new, or on the basis of theory alone; for we have at hand a sufficient number of experiments from which to draw tenable conclusions. * * * We may apply the experience gained in a small way to the establishment of some general rule or principle. Public ownership in some towns serves as a check upon the private management of the same industry in other towns. In the one case (water works) the public have a fairly satisfactory rule of judging what good management is, which in the other case (gas works) is wholly wanting."

At the same time Professor Knight stated: "There are a sufficient number of specific examples (of municipally owned works) in the United States so that we may dispense with theory, if only we can get the requisite information concerning these specific cases."

Since 1888, the number of examples has increased, in water works from 544 to 1,900; in gas works from 5 to 25; in electric lighting works from none to 400. The last figures in each case are estimated. The statistics sought in 1888 have not yet been obtained, therefore, all the discussion, all the action, all of the harm done to private investments during these years has transpired as the result of developing a theory unsupported by facts. In the light of this statement it is difficult to conceive of a service of more vital importance to the urban population of this country, and to the municipalities in which they have made their homes, than will be rendered by making this investigation comprehensive and accurate in every detail. No greater public service can be performed by members of the city councils and municipal officers—especially those in cities or towns that own and operate any of these works—than by cordially co-operating with the United States Department of Labor in every desirable and practicable way in expediting this investigation so that its results may be available within the shortest possible period of time. There is not a mayor,

nor a city council in the United States that has not time and again felt the urgent need of such statistics as this investigation is designed to gather and publish for the information of all the people. There have been many cases where committees of city councils have spent much time and money to secure data such as this, but have not been able to reach satisfactory results. Private corporations have been compelled to suffer heavily in some instances, and generally to experience much disquietude on account of erroneous opinions based on statements unsupported by facts, which could not be successfully controverted because of the impossibility of obtaining the facts from an impartial source which would be accepted by all parties as authoritative. In the broadest and best sense it is to the interest of the people, of municipal governments, and of public service corporations to welcome this investigation and assist its successful prosecution in every way that comes within their respective spheres of action. This is especially true because it will cause existing municipal work to perform a new function of national importance. Municipal cost will become a regulator of price.

The cost of services under municipal ownership and management, ascertained and published as described, will become a regulating force in determining the price for services that will be agreed upon as reasonable to be charged by private corporations everywhere throughout the country. If this were the only purpose of the investigation no interest touched by it could afford to permit it to fail or even to be hindered.

It will be noticed that no reference has been made to the cost to private corporations of the services rendered by them. Such an inquiry is not necessary for the purpose of determining a reasonable price to be charged for the services when the cost of services to municipally owned and operated works is made the basis for comparisons with prices charged by private corporations. In order to leave nothing undone that can be done to render this investigation of the highest importance and value I understand it is the intention of the United States Department of Labor to investigate the cost of services to private corporations in the same form it uses for the investigation of municipal works. In discussing this point, Mr. Barker says: "The Massachusetts law which compels companies to exhibit exhaustive data, couples with the power to collect data, the power to protect a company against unreasonable exactions by the municipality and to preserve its territory against the inroads of rival concerns."

There is, of course, no national law of this character, but I learn the United States Department of Labor will guarantee, as it always does, that the information given shall not be used in a way to enable any one to trace it to the municipality of its origin. This fact will be relied upon to secure from them an unhesitating response to the inquiries necessary to be made in investigating this branch of the subject.

One cannot make an exhaustive examination of this subject without reaching the conclusion that the mistakes of the past and the antagonism to private corporations engendered by them grow out of the attempt to regulate prices by force—the force of competition—instead of basing them on the cost of production. The experience gained demonstrates the fact that the principles and methods of competition cannot be applied to public service industries. They must be protected and regulated as monopolies. Professor Adams has well said: "The end of criticism is construction. Its service should be to point out the way in which men may avoid the recurrence of mistakes disclosed." The evils complained of with so much justice on the part of the people and of private corporations result from the existing system. They cannot be eradicated in the best way without changing the system. What this change should be, its general direction and form, and the reasons for recommending it, are fully stated in the discussion of the economic principles involved in "The Law of Incorporated Companies Operating Under Municipal Franchises." That State which first succeeds in intelligently changing its system, or want of system, of organizing and controlling municipal, political and industrial corporations, by adopting a system in conformity with the outlines therein given, will soonest establish the conditions that will induce the greatest degree of prosperity and well-being for its municipalities and their inhabitants. So conditioned and so controlled, municipal industrial monopolies will become the friends and servants of the people, and will render the best services of which they are capable at the lowest obtainable cost to users. This result is predicted with undoubting confidence because the prediction is based on a well known fact of human nature. The desire for good, joined with a reasonable expectation of attaining it, rather than fear and apprehension, are the forces that quicken the energies of men to their best endeavor. The system recommended is based upon the utilization of the economic value of the energy of hope applied to the production of the means of supplying municipal public services. Those whose only desire it is to secure the best services at the lowest price for users and taxpayers will see that their object can be gained in the way indicated.

WHERE MUNICIPAL OWNERSHIP FAILS.

A glaring example of municipal ownership of electric light plants is found at Moorhead. Many of the citizens are so disgusted with the way the council is handling the lighting system that they have put in private electric plants of their own, and other business men are using Fargo gas.—Crookston, Minn., Tribune.

LETTERS TO THE EDITOR

PLAIN IRON PIPE FOR CONDUITS.

I HAVE taken much interest in the discussion which lately appeared in your valued medium by "Jim Crow," "Bald Eagle," "Doe Bird" and another fellow who gave his right name evidently because The Electrical Engineer is not a police court. The discussion, by the way, was about plain iron pipe as a safe conduit for electrical conductors, and I think I may say that "Jim Crow," while pitted against some clever birds of pretty gay plumage, has made the feathers fly; in short, I fail to see how "Doe Bird" can weather the winter through on so short a shift of feathers and not catch cold, to say the least. In any case, "Jim Crow" has been as hard to digest as crows usually are, and it is just as likely as not that the other birds are glad that the turkey season is now at hand, for I have no doubt that the change will be appreciated by them.

As regards plain iron pipe, however, I am able to testify by virtue of actual experience, that when well put together it is a safe conduit for water, gas and other such material matter, but for electrical conductors it has not the essential features unless it is reinforced by the addition of some suitable insulation. Iron pipe is, pure and simple, a good mechanical protection for insulated conductors, but in itself it falls short of protecting the insulation on the conductors because burrs and condensation, resulting in the abrasing of the insulation on the conductors, together with the penetrating ability of rust, soon effects an end which will defeat the object. At sea I have heard men talk of "hanging by their eyelashes," and I once heard a "haymaker" say he had hung by his eyelashes on the royal yard of a topsail schooner (which kind of a craft has no royal yard). His statement, however, was just as probable as the standard yarn of the real seaman, but I never considered it good practice to hang electrical conductors in such a way, so to speak, the equal of which is to put good copper, however well insulated, in plain iron pipe.

I will conclude by asking "Jim Crow" to deal leniently with the rest of the feathery tribe in future for, with a new crop of down, they will probably see the error of their ways and not forget again that too much insulation is hard to get, if indeed it is not impossible.

LE CHAT.

THE QUESTION OF WAGES HERE AND ABROAD.

I have noticed from time to time in various electrical journals references to the low scale of wages paid for electrical engineers and electrical workers in England and on the Continent. I am, therefore, moved to forward you, attached hereto, an extract from a letter which has recently come under my notice. The offer contained therein will compare very favorably (sic!) with those in the articles noted in some recent English journals. The extract which I enclose seems to indicate that some of the electric plants, "quite near home," are trying hard to reduce their labor expense to a comparatively low basis.

"READER."

The letter enclosed reads as follows:

Dear Sir:—Answering yours of ......, we require a man who is capable to run our engine, arc and alternating dynamos, do the firing, also the arc lamp trimming., making all adjustments and repairs and a man who is capable of doing inside and outside wiring. The work is not hard and we pay $1.50 per day, etc.

NORRISTOWN, PA.—Mr. R. M. Douglass, general manager of the Schuylkill Valley Traction Company, writes us that they have completed the Collegeville Electric Railway, which is in reality part of their system.

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PHILADELPHIA A SUBURB OF NEW YORK.

IN a recent issue attention was drawn to an article by Messrs. C. H. Davis and F. S. Williamson, the first part of which appeared in the October number of the "Engineering Magazine." In that article the authors discussed the engineering details required to construct track, cars, etc., to cover the distance between New York and Philadelphia in 36 minutes. There appeared to be no insuperable engineering difficulties in the way of realizing the object aimed at, but the consideration of the financial side of the undertaking seems to present the case in an aspect more open to discussion. Indeed, the enterprise reminds one very much of the remark of Brassey that it would be easier to construct a tunnel from England to China than to raise the capital for carrying out the work. In considering the financial side of the question, Messrs. Davis and Williamson now assume a number of conditions in addition to those previously laid down. Among them we may cite the following: The heaviest train to consist of five cars; a three-track road with a three-minute headway on each track; trains leaving terminals every minute and a half during hours of heaviest travel; each terminal has room for eighty trains; 10,000 volts three-phase for transmission lines and 1,000 volts direct current on feeder systems; each train to require not more than 10,000 h. p. at the station; each station to have an economical capacity of 30,000 h. p., with a maximum 50 per cent. greater, and each substation 20,000 h. p., with a maximum of 50 per cent. greater.

The figures submitted by the authors are, to say the least, startling. Thus they estimate as follows in their November article:

Right of way and real estate	$27,538,000
Construction	94,583,000
Equipment	27,865,000
General	40,014,000
Grand total	$190,000,000

This would make the cost per mile of single track $745,098! As to the income from the road, the authors base their calculations on the experience of several suburban elevated and interurban roads and place the daily traffic at 93,520 each way, or 187,040 both ways; and making allowances for excursion trains they assume an average daily traffic of 200,000 passengers a day or 73,000,000 per annum; this in the face of the fact that the present existing steam roads connecting New York and Philadelphia carry only 47,000,000 passengers all told, whether local, commuters or otherwise. These discordant figures are considered of no importance by Messrs. Davis and Williamson for the reason that the laws which will govern travel on the proposed road do not apply to existing roads between these points.

The rate of fare is assumed at 20 cents, and without going into details of cost of operation, etc., we submit the authors' figures, as follows:

Gross receipts	$14,600,000—100 per cent
Operating expenses	6,575,250—44.6 per cent
Fixed charges	3,750,000—25.6 per cent
Profits	4,334,750—29.8 per cent

This would allow of a dividend of 4 per cent. on the preferred stock. Lack of space prevents us from elaborating on the arguments which the authors bring forward to sustain them in their assumption of the amount of traffic which the proposed road would attract. It may be summarized in the statement that a reduction in fares over the present charge in the ratio of 10 to 1 will increase traffic 40 to 1, and under these conditions the income will reach the amount stated above.

At the first glance the scheme here outlined seems chimerical, at least from the financial standpoint, and no doubt will meet with ridicule in steam railroad circles. But without endorsing the feasibility of the project in all its details as presented, we are bound to confess that it seems to us worthy of consideration and further elaboration. If it could be demonstrated in advance that the traffic would equal what is assumed, we are not at all so sure that capital would not be forthcoming, but the uncertainty of the traffic factor will no doubt be the first bar to the realization of the project. And yet electric railroading has before this upset all calculations of this nature, as witness the figures submitted by Colonel Heft, on the increased traffic engendered by the equipping of the electrical branches of the N. Y., N. H. & H. R. R. Of course there is a difference between an increase of 4 to 1 and of 40 to 1, but then the proposed fare carries with it a reduction of 10 to 1. These are things not to be considered lightly. With the certainty that they can reach New York in a little more than half an hour on trains leaving every minute and a half who can say how many Philadelphia business men will take the electric train for New York daily, or how many New Yorkers will seek rest and quiet in Philadelphia, where rents are low as compared with this city. Philadelphia might, in fact, become a very prosperous suburb of New York—another Brooklyn. These are things to be contemplated and we cannot but express our appreciation of the evidently earnest effort on the part of Messrs. Davis and Williamson to present the problem in debatable form.

THE GOVERNMENTAL INVESTIGATION OF LIGHTING PLANTS.

THIS week we have received from the Hon. Carroll D. Wright, United States Commissioner of Labor, the schedules that have been prepared by his department for the proposed inquiry into the essential, economic facts connected with the building and operation of municipal and private electric light plants, gas works and water works. We are happy to be able to print, therefore, in this issue the full paper read before the National Conference of Mayors and Councilmen, by Mr. Allen R. Foote, on the "Cost of Service to Users and Taxpayers." That paper deals with the aims of the department and enters into a most valuable, dispassionate review of the whole subject; and it will be remembered that the conference adopted a series of resolutions in favor of the investigation, as printed by us at the time of meeting last September.

Reasons of propriety forbid our printing the schedules that relate to the inquiry into the conditions of electric light and power. The information they elicit will be treated as entirely confidential, and the department therefore proposes to protect in every way the nature of its questions and the responses made in each case. It will suffice to say that the schedules for both the public and the private plants have been made up with great care and that the end sought of showing real costs

is well within compass if the work is done with ordinary intelligence and fidelity.

We believe thoroughly in the importance of this investigation. So far as we know the department has no prejudice or bias, unless perhaps it be a leaning toward government ownership. Of that, however, we have no proof, and even if such predisposition existed in any official quarter, the facts will be there on the records. We confess freely our own conviction that municipal plants do not pay, but if our faith is based on half facts, it is time fuller truth were obtainable, and we want it. For the reason that the facts are all that is asked—no opinions, no politics, no local reasons of feud or faction—we urge strongly upon private companies to assist the department to the utmost of their ability. Quite a popular impression obtains that electric lighting has been a tremendously profitable business, and hence the eagerness to "blow in" public money in the conduct of such enterprises. It would be a nice thing if the big profits were really to be got out of the business, but as they are not, it is as well the public should know it. If lighting companies are well run and not molested, they should pay fairly well and be safe, legitimate investments, but when badly managed and when subjected to all kinds of "strikes" and spoliation, they are rat holes in the ground for the absorption of money. So, too, of municipal plants, where the public funds run the added risk of being always "in politics." As we have intimated, the social or polititel aspects of the case are well understood and not now in question. It is the bare economic facts that are sought for. They are wanted. By all means let us have them.

ELECTROLYSIS FROM RAILWAY CIRCUITS.

THE introduction of the electric railway in cities has had a marked influence on the social side of city life and is admitted to be a powerful agent toward the emancipation of the wageworker from the crowded tenement and its disease breeding and death dealing influences. But the electric railway has also caused some disturbances not so productive of general satisfaction to all parties concerned. The telephone companies early arrayed themselves against it, but the courts have pretty generally decided that the earth is common property as a return circuit and that if trouble is caused in the telephone receiver, it is the telephone company's business to apply the remedy. This has been done and now we rarely hear of a complaint on this score—at least from the telephone companies. But in its stead a new evil has cropped up. Electrolysis, resulting in the destruction of gas and water pipes, has made itself felt, and that in no uncertain degree, and has raised against the trolley powerful enemies in the gas companies and municipal governments. We could mention numerous cities in which the evil has caused much, and no doubt deserved, complaint, the most recent example being Atlanta, Ga. Can electrolysis be prevented? We believe it can and that it requires but the intelligent application of well known principles to entirely overcome it or to make it, at any rate, practically harmless. Good railbonding will do a great deal toward cutting down electrolysis, but not infrequently additional means may have to be resorted to, none of them, however, prohibitory in cost, considering the object in view. The nature of the rail bond, however, is a most important feature in this work. Those who have placed their faith in some forms of bond have been rudely awakened to their inadequacy, and we may recall a recent case in Chicago where a much used joint, though excellent as a mechanical link between rails, has, it is said, been found to deteriorate rapidly in its electrical conducting properties and to have given rise to electrolytic disturbances. We mention this case merely to show the difficulties which may present themselves and what railway companies may have to contend with even when prompted by the best intentions and after the expenditure of considerable money to prevent the evil referred to. The remedy in most cases will be found in a reenforcement of the rail by auxiliary return conductor, to such an extent that the earth is practically eliminated from the circuit. This need not necessarily mean the laying down of copper, as old rails, properly bonded, have been found to answer the purpose admirably. But whatever the method adopted it should be carried out in the best possible manner to insure permanency of the work. The insidious nature of electrolysis requires constant watchfulness on the part of electric railway companies and its surveillance should be entrusted to competent men.

LARGE STATIONS A NECESSITY OF THE HOUR.

THOSE who study the signs of the times must be impressed with the gradual change of opinion and practice which has manifested itself during the past few years in central station work. This change has been brought about largely by hard-won experience, but the recent revival of business activity has accentuated the need of the hour and accelerated the inevitable trend toward a concentration of operating machinery and operating force in single large installations. More particularly is this true of companies operating the low tension systems. The gradually increasing loads and the rapid extensions of area to be covered by the circuits have put more than one central station manager in a dilemma, and have puzzled him to solve the problem how to meet the increasing demand and how to do so with the greatest degree of economy in operation. The substation at the outlying end is, of course, the first plan which suggests itself, but the determination of the character of such a station has to receive the most careful consideration.

The steam substation has, perhaps, seen its best days. There may be cases, of course, where the conditions warrant its erection, but if we interpret aright the trend of recent practice, steam will be employed only in the great central plants which are multiplying on every hand. With high economy expansion engines, high tension distribution to local centers of supply and rotary transformers for local distribution, most condition of actual practice can be met; and this, indeed, appears to be the coming standard practice. We could name several installations of this kind now being carried out, both in lighting and railway work, all based on the fundamental principle of concentration of prime motive power in one place. The recognition of this principle is destined to have a powerful influence on the prosperity of the current distribution industry, which has, we are constrained to admit, not been in the healthiest condition during the past five years, when lowering prices have been added to the losses due to uneconomical working. It may require some courage and the expenditure of some capital to bring about the necessary changes to effect the desired concentration, but we believe the money invested will be well spent. That such is the conviction of wide-awake managers is evidenced by the work now going on, work which is destined to mark an epoch in central station operation.

STREET CAR VESTIBULES.

ONE or two street railway companies have been getting into trouble because of their reluctance to carry out laws as to furnishing a "vestibule" for the motorman to be housed in during the winter months. That there are many practical objections to the vestibule enclosure, is known to all who are familiar with trolley car operation, and it is by no means certain that the motorman benefits by the alleged protection given him. In the struggle now going on over in New Jersey General Manager Young has not hesitated to express his conviction, held by many other managers, that accidents are far more liable to happen with the vestibule than when they are not used.

In this connection it may be noted that the Bridgeport Traction Company has just adopted a protector which will be used by the motormen during the winter months. This is merely a square of plate glass which will be suspended from the roof of the car by iron bands in front of the motorman's face, and will be changed from end to end of the car. The sides, top and bottom of the front will be left open, the object being only to protect the faces of the men from the cutting blasts which a rapidly moving car raises in winter. The faces of the motormen will have the appearance of oil paintings, framed behind glass. This method may be the solution of the difficulty.

ELECTRIC TRANSPORTATION

THE DEVELOPMENT OF ELECTRIC CABLEWAYS.[1]

BY RICHARD LAMB.

THERE are millions of feet of valuable timber in swamps standing within rifle shot distance of convenient points of navigation that have been practically unobtainable. The miry soil makes regular roadbeds too expensive and it has been as impossible to get the teams into the swamps as to get the logs out. It was to solve this particular problem of abridging distances that my electric cableway was built.

I first built a cableway, having portable iron bracket supports to attach to the trees and an endless cable supported by sheaves upon the brackets. The cable was passed around a sheave which was driven by a steam engine at one end of the line. This cableway worked well, and could haul logs for a distance of half a mile, which is farther than by any other method previously tried. I found that steam cableways are limited to straight lines, and as trees do not always grow in long, straight lines, I devised a means by which the car would replace the traction cable in its sheave if it was dislodged in passing a bracket on account of the cable line not being straight. But this did not obviate the difficulty of having to select the route with reference to a straight line.

It is important in the electric cableway to have the traction cable always parallel with the bearing cable. Supposing the incline of the cable is raised until it is vertical, we would then have an elevator; the bearing cable being the guide and the traction rope the hauling rope, the motor being on the elevator car instead of at the top or bottom of the shaft. It is this feature that enables this system to operate on grades that would be impracticable by other methods.

This system consists of a carriage with grooved wheels in tandem that move upon a cable or suspended trackway. From this carriage is hung a frame, pivoted to the carriage so that it can maintain a vertical position regardless of the grade of the track. This frame holds an electric motor, preferably of an iron-clad cylindrical type. The motor is geared to an elliptically grooved sheave. A steel cable is wrapped around this sheave two or more times and is anchored at both ends. For the sake of economy in conductors, the upper or bearing cable is insulated from the lower or traction cable and is used to carry the electric current. The carriage is insulated from the suspended frame and motor. An insulated wire is attached to the carriage and conveys the current to the rheostat. The other pole of the rheostat is connected with a convenient part of the suspended frame. The rheostat is designed to control the speed and reverse the current. A circuit breaker is put in circuit. Tracing the current from the generator, it passes along the bearing cable to the carriage, thence through the insulated wire, through the rheostat, to the frame of the motor, thence through the traction cable, back to the generator. At intervals along the line connection is made between the traction cable and the ground. A bar of copper-coated iron is buried at the foot of a tree or post to which the cable brackets are attached. A well bonded copper wire extends from this ground plate to the lower bracket, upon which the traction cable rests. In swamp and canal service the plate is buried well into the moist earth.

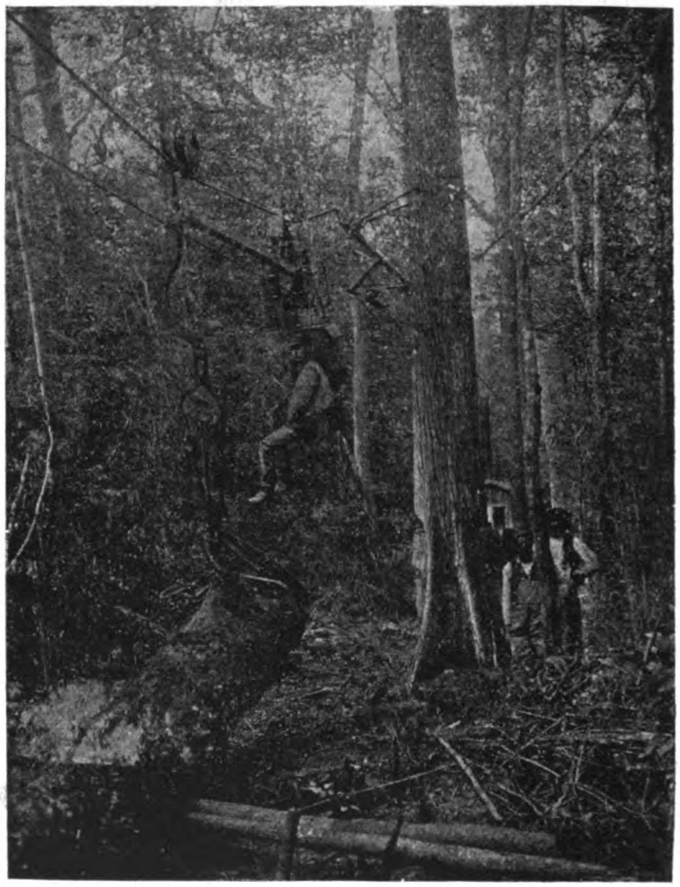
In making the first saddles to support the cable they were designed for movable brackets, which can be easily put upon trees and removed to other trees when the line is changed to a different location. These saddles have a U-shaped clamp that goes over the cable and is bolted down with wedge-shaped bolts. Under the saddle is a petticoated recess, designed to shed rain water from the insulation placed between the saddle and the bracket to keep the current from grounding or short circuiting.

This develops a new feature in insulation. It appeared that many of the materials ordinarily serviceable for insulating were not available owing to the fact that often a rolling load of 10,000 pounds or more passes over the brackets, producing a grinding and crushing effect.

Lava, hard rubber, micanite, shellac, mica and its products, glass, porcelain, ozite and all products of rosin, proved to be too brittle. Vulcanized fibre was finally used and proved quite satisfactory for a time. As only 220 volts are used in logging plants, and as it is an advantage from a construction standpoint to have the insulation as thin as possible, sheets of fibre one-eighth of an inch thick were used, all other insulators proving ineffective. Short circuiting was averted by painting the saddles, brackets and fibre with insulating paint. This was found to work all right.

The saddles for the plant for the Erie Canal towing test, referred to hereafter, were made so that the tread of the bearing wheels would leave the rope, and the wheels would pass over the saddles on their rims, guided by flanges cast upon the saddles. On curves these flanges were made concave or convex as required. These saddles worked excellently, and the motor passed over them easily and satisfactorily. These brackets were insulated with ozite and vulcanized fibre and painted with insulating paint.

Work in swamp logging demonstrated that small short saddles are all that are needed, even for deflections in the line of from 20 to 25 degrees. The saddle was much simplified by attaching to the brackets an insulated cone-shaped pin, over which the saddle is placed, by having a cone-shaped recess in the under part of the needle to fit the pin. This recess also acts as a petticoat to protect the insulation. The question of insulating the cone-shaped pin was an important one. Vulcanized fibre could not be molded upon the pin. A material was needed that, while having a high resistance, would adhere to the pin, and that would stand a great crushing strain. It should be preferably non-hygroscopic, and show a minimum absorption of water.



LOGGING MOTOR WORKING IN SWAMP.

Insulated trolley hangers were secured that showed an insulation resistance measured under 150 pounds vertical stress above 300,000 megohms, and after sprinkling with water one-half hour, measuring immediately above 300,000 megohms. After again sprinkling with water twenty minutes, they measured immediately above 300,000 megohms. In the insulated stud made for the saddles, the breaking strain measured over 35,000 pounds. The material is known as colophite.

The best steel cables for cableways are the interlocked and patent locked wire rope. These are almost as compact as solid bars of steel, and yet can be easily coiled by hand in coils four feet in diameter. A simple coupling is used to connect the cables. The wheels of the car pass over these couplings so smoothly that the rider on the motor scarcely notices the fact. These points of connection are as strong as any section of the cable. An advantage in these interlocked cables is that they present a smooth surface of compara tively flat steel,

[1] Abstract of a paper read before the Am. Inst. E. E.

which wears a great many times longer than the ordinary cables whose surfaces present round wires that wear through and unravel. These cables are made to bear much greater strains than the ordinary cables, and being so nearly solid they make much better electrical conductors.

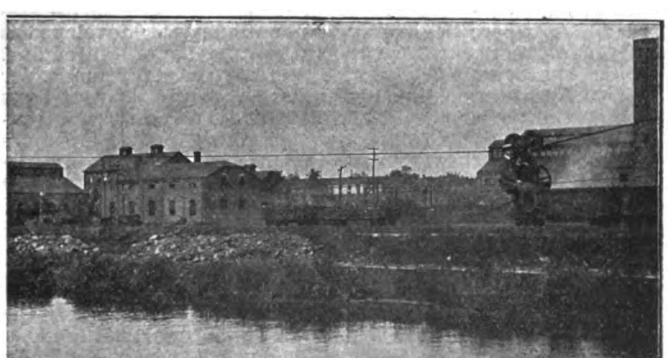
The traction cable is made of ⅝-inch or ¾-inch specially strong "19 wire" steel rope, with a soft iron wire core, in place of hemp, which is ordinarily used. This increases the conductivity. One of the most remarkable results in practice in this system is the fact that the traction cable does not have to be pulled very taut, in fact a sag in the cable seems to be of no disadvantage, as the motor does not tighten the line far ahead, even when doing considerable service. The sag adds to the weight of the cable and to the friction on the brackets, and these two resistances act as an anchor for the traction cable, independent of the terminal anchorages. For example in the case of a trial plant for a German canal the resistance to be overcome by a motor, or its "draw-bar pull" was to be 645 pounds. Now at one pound per running foot of traction cable, the influence of the motor pull would only be felt 645 feet ahead of the motor. Therefore with motors distributed 645 feet apart, each one practically has its traction cable anchored from the motor ahead, and, in consequence the combined pull of all the motors is not exerted upon the terminal anchorage.

In canal practice the terminals will be ten miles apart, with tension stations every two miles. At the terminal stations rotary transformers will transform the high voltage alternating current to 500-volt direct current, and send the same each way a distance of five miles. Where the traffic justifies, a line will be placed on each side of the canal, when the insulated or bearing cables will be connected at intervals to feed each other. The anchorage of the traction cable will be made with a series of clamps, and the motors will be passed through them as canal boats through locks. At the end, the motor is released from its traction cable and is conveyed across the canal on a cable, or where masts are allowed on boats in the canal, by a hinged trussed track that can be opened like a gate, or raised out of the way. The handle of the rheostat is easily controlled from the boat by a cord attached to the handle. When the cord is pulled from the opposite direction to which the motor is to be run, the current is admitted in the proper direction, and the motor proceeds. When the cord is released the handle flies back to a vertical or cut-off position, and the motor stops. When two boats pass they exchange motors by simply exchanging towlines and controller cords.

The first test of canal boat towing with this system was made on the Delaware and Raritan Canal at the Trenton Iron Works. The motor was made to go over concave and convex curves and up and down grades while towing the boat.

In reference to the test of canal boat towing on the Erie Canal, at Tonawanda, it is not necessary to make any apologies for the system. Superintendent of Public Works Aldridge, in his report to the Legislature, unqualifiedly indorsed the system.

In the report of Chas. R. Barnes, electrical expert for the Public Works Department of the State of New York, he sums up by saying: "The electric towing system appears to present

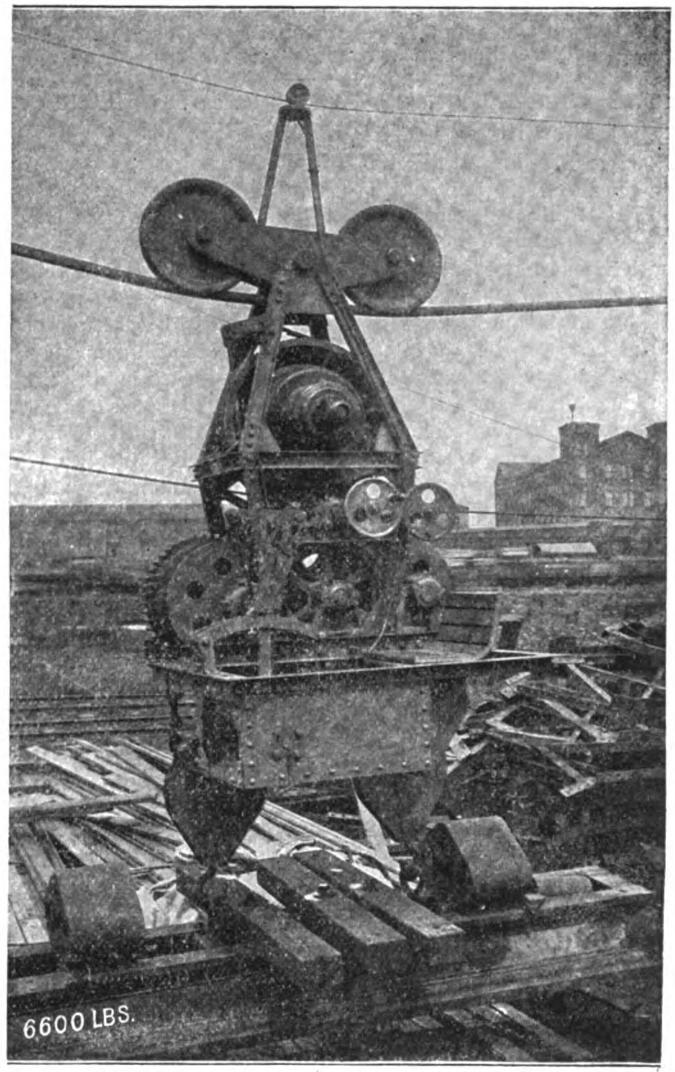


"Finow" Canal Motor on Cable Line.

so many meritorious features that I have no hesitation in endorsing it as the system deserving preference over any other hitherto experimented upon, or likely to be devised in the near future."

So short a time was given in which to construct the trial plant that existing models had to be copied. The motor was over nine feet in length; it weighed 2,213 pounds.

In the plant recently constructed for trial on a German canal, the motor has been shortened to less than five feet in length; its weight reduced to 1,300 pounds. The worm-gear has been avoided by a double reduction direct gear, gaining 50 per cent. in efficiency over the worm-gear, and the elliptically grooved sheave has been placed about the cylindrical electric motor, getting a large bearing surface and increasing the efficiency accordingly. At the test made at the Trenton Iron Works this motor, using a 5 h. p. Storey motor, wound for 500 volts, and going at the rate of 2.3 miles per hour, pulled 800 pounds when having the use of only 220 volts. This shows a remarkable efficiency, which is due to the mechanical principles utilized, viz., hauling the motor along by a fixed rope, attached to a capstan operated by practically a winch.



Loaded Crane on Cable.

The uses to which this method of telpherage can be put are so numerous that I will not attempt to give descriptions of plans that have been, and are now, being made for various parties, for such services as fortification work, rice culture, mining plants, ship building and sewer excavating plants. I will confine my descriptions to completed work.

Possibly the most universally serviceable application that has been made of the system is traversing motors with double hoisting drums for quarry purposes. These motors are to go on 700 feet span cableways. Each of these cableways has one end stationary and the other is movable on a curved track. It is designed to lift 10,500 pound rocks at the rate of 100 feet per minute and traverse at the rate of 600 feet per minute. A 15 h. p. Storey motor is used.

In a place within reasonable distance of an electric plant having surplus power, these electric cable hoists can be erected and operated for a comparatively small cost. In contracting work, where electric lights are also used, these cable cranes can be used to great advantage. In other places the small generating plant necessary to operate these motors will add but little to the expense of an outfit.

Those who think that electrical machinery is of such a delicate nature that it is only serviceable for cities of advanced civilization, should go to the Dismal Swamp, and see a so-

called dainty machine doing as rough and dirty work as any service to which a machine could be put.

In spite of the lack of electrical information of the logging crew, no inconvenience has been occasioned on that account. All features of insulation are provided for before the plants are shipped. An ordinary steam engineer acquires quickly the necessary information for running the dynamo. The motor is shipped with all parts adjusted, and the extent of the motorman's duties is simply to push the handle of the rheostat according to the direction he wishes to go.

The light first cost, the high efficiency, the ease with which it can be operated by ordinary mechanics, portend for this system an important place among the useful applications of electricity of this century.

THE APPLICATION OF ELECTRICITY TO RAILROADS NOW OPERATED BY STEAM POWER.[1]—II.

BY COL. N. H. HEFT.

(Concluded.)

OUR third rail and return circuit experience will perhaps be of value to both street railway and railroad managers, as we have undoubtedly made a wide departure from established methods. We have solved a number of interesting problems. First is the question of insulation. The third rail has a potential of 600 volts above the ground and rests upon creosoted wooden blocks dowelled into the ties, its eaves being only 1⅝ inches above the tie. Now, it frequently happens that water accumulates two inches or more in depth over the ties, and, if it were not for our experience to the contrary, we would naturally suppose that, under these circumstances, the line would be directly short-circuited between the third and service rails through the water, the distance being but two feet each way. Nevertheless, we have been able to operate our road without the slightest difficulty when this has happened, and nothing unusual has been noticed at the station, nor has the electrical output, as registered by the recording wattmeter been abnormal. At Berlin we have watched the ammeter closely when we knew the tracks to be submerged in two places ten miles apart, during a heavy rainstorm, and have found that the leakage was almost imperceptible when both cars on the line were at rest and their air-pumps out of circuit. At the same time the wattmeter was standing still. Of course, if a long length of track was submerged, the leakage might become serious, but we have yet to learn how much is necessary to accomplish this result.

We aim to so connect our third rail lines and the service rail return as to have a practically complete metallic circuit of extremely low resistance, as far as possible disconnected with the ground. We do not believe in grounding our track, and, though ground plates are placed at the station, connected to our generator, by far the largest proportion of the return current comes through the cables connected directly with the track, the percentage coming from the ground plates being extremely small.

The joints of the third rail are bonded by long copper plates, firmly bolted to both sides of the joint, sixteen bolts being used in all. These copper plates are tinned before being put into position. Owing to the large area of contact surface, the presence of rust on this surface does not materially interfere with the conductivity of the joint, as shown by accurate tests. The service rails are bonded with the greatest care, four copper leaf bonds, having a cross section of copper equal in conductivity to that of the rail, being used.

A few words about the danger of the third-rail system would be, perhaps, in order. There have been many cases of people who have stepped from the ground to the third rail without feeling the current, and any one can step upon it from a dry tie without the slightest effect. On all except wet days, our employés work about it without trouble, avoiding, of course, putting themselves in direct contact with both service and third rails, but not infrequently "monkeying" with the current in such a way as to get shocks of more or less severity in a sort of horse-play. On wet days they refer to the third rail as being "lively," and are inclined to let it alone. Many of our employés have, however, received the heaviest shock possible to obtain, time after time, and care little about it, though those who are more influenced by electric shocks than others are sometimes thrown off their feet, but recover fully in a few minutes. We do not say that the third rail has no dangers, but we do not consider the danger as being at all serious or one which should interfere with the extension of the system.

[1]Read before the American Street Railway Association at Niagara Falls. Abstract.

As a result of exceptional care which we have taken in bonding our third and service rails, we have found it unnecessary, in any third-rail work so far done, to use copper feeders, in spite of the fact that we are obliged to transmit current from Berlin to Hartford, a distance, as before stated, of 12.3 miles, straight away from the power station.

COST OF POWER.

In our Nantasket Beach station we have installed two engine generator units of 800 h. p. each and 550 k. w. capacity each. The steam is supplied by eight boilers of 200 h. p. rated capacity each. On heavy days both these engines are required, but on ordinary days only one, and this is not fully loaded; the average loads being, perhaps, one-half the maximum.

In the Berlin station we have installed two engine generators of 1,200 h. p. and 850 k. w. each. The steam is supplied by ten horizontal tubular boilers of 200 h. p. each. One unit only is required in the practical operation of all the cars on the Berlin and Hartford lines, and the average power output is hardly one-fourth of the maximum capacity. In both stations our aim has been not to follow out any engineering fads, but to provide apparatus proved by long experience to be of the most simple and durable character.

In spite of the fact that the general conditions of operation do not point to a low cost of power, because of the fact that we are working neither station at anywhere near its full capacity, I suppose we are, as a matter of fact, producing power more cheaply than can be done in any power station in the country using coal as a fuel, the reason being that we are burning sparks. "Sparks," as we are accustomed to call them, are the half consumed coal dumped from the extension front of locomotives at the company's various round houses. Nevertheless, there is a great deal of steam generating value in these sparks, as we have found by experience, and they are being carried on the company's cars to our stations at Berlin, Nantasket and Stamford, and charged to the electrical operation at the cost of freighting (including the usual profit to the company for transportation), plus the cost of loading and unloading, a total charge of 70 cents per ton delivered.

In order to burn these sparks we are obliged, of course, to make some changes in the furnace arrangements, chief among which is provision for the introduction of live steam under the grates, forming a blower or forced draft as well as providing the water which, in decomposition, furnishes the oxygen and hydrogen gases which increase greatly and facilitate in combustion of half burned coal and add enormously to the furnace heat. Of course, we have to use a greater weight of this half-consumed coal than would be the case with new coal, but still the economy is great, as a good quality of run-of-mine coal costs us, in Connecticut, about $3 per ton delivered at power station.

A few figures as to the cost of power at Stamford may be of interest. This station furnishes current for our street railway system at Stamford and for lighting our railroad stations with 350 incandescent lamps. We are operating one engine only of 500 h. p. total capacity, direct connected to one 300 k. w. generator. In the boiler room are six 200 h. p. boilers. For the first six months of full operation with sparks only the total cost of fuel for this station amounted to 3 mils per h. p. hour or 4 mils per k. w. hour. For so small a station and one where the average amount of power developed is hardly more than one-third the rated capacity of the engine, I believe this to be a low figure. We have recently made, for our own information, for use in larger plants, special tests of the cost of power developed in this way, using for this purpose a water rheostat in order to load the engine up to more nearly its full capacity. As a result of these tests we find the cost of fuel for power, with the use of coal, to be 3.2 mills per h. p. hour and 4.2 mils per k. w. hour. With the use of sparks the cost is reduced to 1.9 mils per h. p. hour, or 2.5 mils per k. w. hour.

At our Nantasket power station this season the cost of fuel, with the use of coal, has averaged 4.2 mils per h. p. hour, or 5.6 mils per k. w. hour, while, with the use of sparks the cost has been 2.1 mils per h. p. hour, or 2.8 per k. w. hour.

As before stated, our Berlin plant has not been run as economically thus far as it will be when a greater load is put on the engines and it will seem to be in the interest of economy to run compound condensing. At this station, the cost of fuel, with the use of coal, has been 9 mils per h. p. hour, or 12 mils per k. w. hour. Using sparks as fuel has reduced this cost to 3 mils per h. p. hour, or 4 mils per k. w. hour.

It is very difficult, of course, if not impossible, to make any direct comparisons between the cost of motive power for electric railroading and that for steam railroading, on account of the different way in which the trains are made up. The best criterion would be the cost of motive power per ton mile hauled, but even here the results would be of little value on

account of the wide difference in conditions, and, as a matter of fact, we have never attempted to make such comparisons.

I have tried to give you, as briefly as possible, some of the results of the pioneer work which the New Haven Company has been doing in heavy electric railroading. They are roughly stated, and we cannot pretend that they are in any way conclusive as affecting general railroad practice. For ourselves, however, we have formed some definite ideas as to what is possible for us to accomplish, and our plans for the future are being made with great care by President Clark and the Board of Directors, with the intention of dealing with the new transportation conditions which confront us in a broad-minded and progressive way. It is felt that a great transportation agency of this character owes it to the public from which it has obtained its franchises, to furnish the best possible service and to make the most of the natural advantages which it possesses.

There will always be room, doubtless, for railroads of two characters, the one operating on a purchased right of way, where trespassers can be kept away and high speed obtained, and the other operating on streets and highways, where passengers can be taken up and let off at their own doors. It is possible that, in some thickly settled districts, such as are found in New England and the Middle States, where population groups almost touch each other, these two classes of service may occasionally be performed by the same agency, but there is no reason, ordinarily, why there should not be the most amicable and friendly relations, and not infrequently of a business character, existing between steam railroad and street railway companies.

MUNICIPAL OWNERSHIP AND OPERATION OF STREET RAILWAYS.—III.

BY P. F. SULLIVAN.

(Concluded.)

"IN the cities of Europe millions have been spent on the quays and docks. Take, for example, the magnificent Victoria Embankment on the Thames at London, the quays of the Seine at Paris, and the embankment on the Neva at St. Petersburg. Few American cities have been willing to improve the water fronts properly. If our water fronts were improved, economically and carefully, they would meet with the general approval of the intelligent citizen, but so may large cities are cursed with king rule that the suggestion of a general system of stone embankments and docks (either on bays or rivers) arouses universal objection and indignation.

"Several years ago a dishonest contractor was constructing a sewer near Central Park, in New York. He was in great haste to obtain his money, and, instead of using pipes, he laid barrels in the ground, for which he received the contract price.

"As I write, municipal officers of all grades in many of the large cities are now under indictment, and many more would be added to the list if it were not for corrupt police magistrates, packed grand juries and negligent attorneys."

("Municipal Reform in the United States," by Thomas C. Devlin.)

"The science of municipal government in this country is crude. Our methods are expensive and our governments inefficient. The burden has become oppressive, and nearly every city in the land is making some efforts for reform, and there are no cities where the same are not necessary.

"That there are able and well meaning men in all these reform movements no one will question, but there are also 'sorehead' politicians who nourish the rancor of defeat, and hare-brained theorists who have never had one practical thought in matters of personal interest.

"In summing up the shortcomings of American cities, it has been very easy to make comparisons with European cities and to suggest the adoption of the same principles of government and methods of administration under which those cities have been made models of efficiency and economy. It is, however, the opinion of those who have studied most carefully the municipal problem in the United States that no material aid can be had from the adoption of European methods in matters of city government.

"The matter of franchise is one of the most distinguishing features between American and European city governments, and which in a measure renders the adoption of European methods impractical. All the powers of government in Europe are in the hands of the property owning class. In Germeny the three-class system of voting, while affording the masses a pretense of power, gives to the wealthier classes absolute control of municipal affairs. A study of the franchise in American cities shows that the non-taxpaying voters are a large majority. Taking Boston, for instance, the registered vote of Boston in 1892 was 73,000. There were 32,407 taxpayers, of whom 3,200 were women having no vote and about 700 aliens or non-residents. Deducting the taxpayers who are non-voters, leaves 28,507 as the number of property holding votes out of a registered vote of 73,000. If every taxpaying voter voted, this shows the non-property vote at 46,693, against a property vote of 28,507.

"Every large city is practically in control of the non-taxpaying element, and from this class the intemperate, vicious and purchasable vote is mostly composed, and it is through his influence with them, and his ability to handle them that the ward politician secures his own election and achieves success for, and standing with his party. The Hon. Seth Low tells us that in every year of his term of office he was compelled to oppose at Albany, the seat of the State Legislature, legislation seeking an increase in the pay of policemen and firemen, without any reference to the financial ability of the city or the other demands upon the city for the expenditure of money. * * * * * New and useless offices were sought to be created and the mayor found that not the least important of his duties as mayor was to protect the city from unwise and adverse legislation on the part of the State. Edward W. Bemis, writing in 'Public Opinion,' says: 'A recent chief of the Chicago Sanitary Department assured the writer that there were not six of his hundred subordinates whom he could trust. It was useless to dismiss any one, for the chief must take in his place whomsoever some alderman may desire.' Not infrequently new offices with chiefs and many deputies are created for no real purposes other than the positions they offer. The pay is often out of all reason for the service rendered."

The advocates of municipal ownership point with pride to the postal service of the United States, and would have us infer that in all things the national and municipal governments could do likewise. In this they speak as partisans, yet we should not deny them such comfort as they may get. They do not refer to the annual pension appropriation, now $150,000,000 per annum, nor to the fact that the late General Grant and the late General Garfield, both good authorities, stated that $40,000,000 would be amply sufficient. They do not refer to the river and harbor appropriations, of which the late President Arthur wrote in one of his veto messages, "as the measure (river and harbor bill) became more objectionable it would secure more support." They do not refer to the National Government's experience in Union Pacific or to the experience of the State of New York in the Erie Canal.

STATE OWNERSHIP OF RAILROADS.

The experience of France and Brazil with government ownership of railroads is not encouraging to the advocates of the idea that railroads should belong to the people at large, and should be operated by officers appointed by the government. The South American Republic has determined to abandon State ownership of railroads, after a thorough test of the theory, and is now negotiating with European capitalists for a lease of the entire system, comprising 14,000 miles of track. When Brazil took charge of the Central Railroad that corporation had paid as high as 9 per cent. dividends, but under government control it has not only failed to earn its expenses, but has cost the people $2,000,000 or $3,000,000 a year above its receipts. The experiment of State ownership of railroads has been tried longer in France than Brazil, and under more favorable conditions. The model road there runs through well populated districts, with large cities as terminals, but the results in France are discouraging. Eighteen years ago a railroad system was constructed which was to furnish cheap rates for passengers, cheap freight for shippers and abundant profit for the State. It has done none of these things. At first the advocates of the enterprise insisted that only time was required to prove the wisdom of the project. Eighteen years have passed and the results may be briefly summarized. Theoretic methods have been abandoned, and the railroad is now managed substantially as are those in the hands of private capitalists, except its tariff of rates is a little higher, and its cost of operation is considerably larger. The last report shows that the net return on the whole capital expended is 1 35-100 per cent., and even the State cannot borrow money for less than 3 per cent. The government has every year a considerable deficiency to settle, and the people who use the line pay somewhat more than they would have done if the enterprise had been left to private capital.

Canada has had an experience of State ownership also, but upon a more limited extent. There the government owns about 10 per cent. of the whole, upon which it loses about $500,000 annually. The railroads and their equipments and fares of France and Germany operated by the government cannot be compared with those of England operated by private capital; and the manufacture of tobacco and cigars by the government of France has produced such vile stuff as to be an object lesson to enthusiasts of government monopoly.

PUBLIC OWNERSHIP AND PRIVATE OPERATION.

Some of the advocates of changing the present state of things stop short at the operation of street railways by the municipalities and advocate that the municipalities own the tracks and lease them to private capital. They are aware of the present condition of our administrations and dare not go to the logical length of their position. If our municipalities are so unbusiness-like and corrupt in their methods as to be incapable of operating a street railway property, then they are also unfit to manage the construction of the property and to make contracts for its use. You cannot stop half way. The motive for public ownership abroad is twofold. The first has reference to the conditions of the streets and street surface. They have, as a rule, finely constructed and maintained streets, and in their very proper regard for keeping them so they desire to control all construction and maintenance of tracks. The second has refernce to controlling and regulating the method of operation. That has proven a failure, and can be accomplished better when granting a franchise. In nearly every case in England where the municipality has acquired the operation of the property it did so involuntarily.

The city of Toronto, Canada, is the only instance in America of public ownership and private operation. The conditions and contract there please the theorists and the street railway company, and all are happy. While I am neither a prophet nor the son of one, I will state that, in my opinion, before the contract period shall have expired Toronto will have cause to regret that it adopted some English methods under almost American conditions. The municipality constructs the concrete bed for the tracks, supplies and does all paving, and removes all plowed snow. The compensation which it receives per mile of track is much less than that paid in some States by one company for running over the tracks of another company. Percentage of receipts, rates of fare, etc., should be looked upon as nothing more nor less than a premium for which the operating company receives a monopoly. Competition and the fear of it are completely shut out. Single fare and transfer carry a passenger only to the suburbs. Those going to and from the suburbs pay extra fares and as the city grows in population it will become as congested as foreign cities, or the people will be compelled to pay extra fares to get to and from suburban homes. Such conditions exist nowhere in the United States. The conditions with respect to Toronto and its suburbs suggest a practical problem in the United States should municipalities desire to acquire street railway properties. Usually abroad, street railway systems are operated within the limits of the municipality, as at Toronto. Should the systems be extended further additional fares are charged. In the United States, on the contrary, in nearly every instance the street railway system extends beyond the city or town limits, and usually only a single fare is charged. Should a city obtain the street railway system within its own jurisdiction an interesting problem is opened with respect to the owner of the balance of the property; and in case the balance of the property should be acquired by the other towns through which the system may be operated, as to divisions of "spoils," profits and losses. It may result as it did in Birmingham, England, in the price of gas. That city provides its own gas and charges suburban towns 50 per cent. more than it charges its city consumers.

POWER DISTRIBUTION AND THE USE OF MULTIPHASE CURRENT TRANSMISSION FOR ORDINARY STREET RAILWAYS.—III.

BY MAURICE HOOPES.

(Concluded.)

In the selection, from the various systems of distribution, of the one best adapted to a particular instance, there is always a large number of variable factors to consider, and usually more or less speculation as to the values of certain ones on which no accurate data are accessible. The writer has given his ideas as to the comparative infrequency of cases in which the three-wire system is desirable. The booster has a very much more general application, and is suited to a greater number of cases than in any one of the other systems. Nevertheless, wherever work can be handled by a special generator, it should be, unless the change involves abandoning existing apparatus. The last method saves considerable over the booster, and is preferable for its simplicity. The only limiting condition to its use is satisfactory regulation. The alternating current system, with rotary converter substations, competes with the booster system and special generator in cases where the load factor (the ratio of average to maximum load) is high, and where the regular 500-volt transmission will suffice during only a few of the twenty-four hours. In such a case, the copper losses, because of the length of time during which they are excessive, are so great that they may often exceed the entire expense of an alternating transmission system. The latter system also enters into competition with the independent power station for that class of business that is too remote from an existing station to admit of satisfactory handling by the other transmission methods, and too small to furnish load for such a station as may approach in economy the station from which the alternating transmission would be operated.

In comparing the systems, it is necessary to compute the annual cost of each, including the items in the following list:

Alternating Current.	Direct Current.
Fixed charges and repairs on main station static transformers, if any, and on substation static, and rotary transformers, and accessories.	Interest, depreciation and repairs on such increased cost of engines and generators as is occasioned by their being fitted to furnish increased voltage.
Fixed charges on substation land and buildings.	Cost of fuel to produce output representing difference between losses in direct current feeders and those in alternating current feeders and transformers.
Substation labor.	

This assumes that the same amount of copper is used in each system, that the alternating system does not remove the need for sufficient copper to handle the load with direct current during a part of the time, and that this amount of copper will suffice for heavy loads by means of the increased direct current potential transmission. In the comparative estimate, the results depend more upon the load factor than on any other condition. With it sufficiently high, the alternating transmission may show an economy over the direct current for areas within a very few miles of the power station. Unfortunately, however, the yearly load factor is usually very low on railroad work.

While, in the writer's opinion, the majority of cases may be best handled by direct current distribution, there are many instances of need for a distribution system where none but the alternating current system is applicable. Where water powers are used, they are almost always so remote from the center of load that very high potentials must be used for economical transmission. Long interurban roads operating so few cars that load can be had for only one power station, bring a condition where distribution must be so accomplished by substations, on the alternating system. The Lowell transmission presents a case where it was a problem whether to care for the new territory with a separate station or to transmit from the existing station. Mr. Sullivan, the general manager of the company, has kindly furnished the writer with a copy of the estimates from which the choice of systems was made. He states that operation justifies the estimate in its statement of the cost of the multiphase system. It showed the cost of power delivered to the trolley wire to be, for the transmission system, 70 per cent of that for the separate power station. There were no figures showing what this work could have been done for with a booster system. Inasmuch as the latter method has been used successfully in place of the other, temporarily, it would be interesting to know its comparative cost. Tests of the Lowell system extending over eighteen days show an all-time efficiency of 76 per cent. as measured from alternating generator output to rotary converter output, the losses being those of two sets of static transformers, line and rotaries. The maximum efficiency for any one day was 73 per cent. The voltage regulation at the substation is about equal to that of a well governed steam driven power station.

The writer has said that the use of alternating currents for ordinary electric railways is limited to the rotary converter system. This is due to the fact that alternating current motors, in their present state of development, are not adapted to the needs of such railways. As yet their use for traction purposes is limited to a few European roads, of which the best known is in Lugano, Switz. Alternating motors have the disadvantages of limited torque and tendency to synchronism. This makes them poorly adapted for the uses of any line but one having long runs at practically uniform speeds, and few stops. These conditions are those of a through express service between cities. Accommodation and ordinary street railway services are such as can only be handled satisfactorily by direct current motors. The ideal system has been thought to be one composed of a generating station containing large multiphase generators, with lines distributing current at a potential high enough to require but a comparatively small amount of copper, static step-down transformers, and motors that may be regulated throughout all desired variations of speed by merely changing the impressed e. m. f. with a controller depending upon the use of various ratios of transformation. This dream included the freedom from the care of commutators, and pictured a car equipment that would need a minimum of attention. Were is possible to realize all of these

advantages, it is probable that the somewhat serious complication introduced by the necessity for two trolley wires might be tolerated. There seems to be little probability, however, of an early solution of the problem of adapting the alternating motor to the intermittent work of the street railway.

DISCIPLINE OF EMPLOYES.[1]—II.

BY GEORGE H. DAVIS.

(Concluded.)

BASED upon the above, applicants having the highest standing are given the positions as extra motormen and conductors as fast as vacancies occur. If inexperienced men are employed at all in the service, they are taken on as conductors and kept in this position for at least six months, and for three months they work without pay. After this work as conductors they break in as motormen, with motormen already in the service who have the highest standing. After six months' service of this kind, they are given their examination and are placed on the lines of the company as extra motormen. To determine the relative standing of employés a system has been adopted which takes into account, first, the general quality of a man's work, according to the judgment of the foreman in charge; second, the value of the special acts in his service as reported by foremen, and marked in the record of the employé according to a fixed scale kept in the main office. To illustrate, in the department of transportation, for motormen and conductors, blanks are prepared which contain the names and numbers of every motorman and conductor in the service. At the head of these blanks there is a personal letter addressed to the general manager, which is as follows: "Dear Sir:—According to my best judgment, the quality of service rendered by each employé coming under my observation in my department of the service, being fairly and honestly estimated for today is as follows:" Opposite the name of the motorman or conductor there is a blank space left for the mark of the foreman. Each foreman, inspector and starter has one of these blanks, and marks after the conductor's or motorman's name the quality of his work for the day, and sends the blank to the main office the next morning. He marks "v. e." for very excellent, "e" for excellent, "g" for good, "f" for fair, "p" for poor and "v. p." for very poor. In the main office these marks are reduced to an arithmetical basis and placed in the record of the employés. In determining the marks to be placed in the record, the marks of all foremen, inspectors and starters for a given man are added and the mean taken, which is considered the final mark. In this way the average judgment of perhaps ten different foremen in regard to an employé's work is obtained.

The marking of the special acts of an employé is on a more definite basis, and has no connection with the judgment of the foremen, inspectors and starters. They simply report the acts. Based upon bulletins, instructions or orders issued, and also upon experience in good railway practice, two lists of acts of employés are made, one delineating all the desirable or commendable features of the service of an employé; the other all the undesirable or intolerable features. For each of the acts in the commendable list, a certain number of points of merit are always given. Similarly for each of the acts in the uncommendable or intolerable list, a certain number of points of demerit are given.

The marking for general daily reports, together with reports of special acts, is kept in a record book, which allows four pages to each employé, each of the pages being numbered to correspond with the employé's badge number. Acting upon this principle, favoritism among officers is almost completely eliminated. Some men might be favorites with two or three officers, due to outside circumstances, but this would never extend to the whole ten, or even five.

The second principle used in the estimation of the quality of the service is embodied in the fact that a more just and unbiased decision can be reached in regard to the merit or demerit of an act, if judgment has already been passed on an exactly similar case. Now, by the system of marking, a list of all possible cases is prepared, and judgment passed upon them, by the general officers of the company, the relative number of points of merit and demerit being fixed. Now, when an act occurs, it only remains to locate it in the list to pass judgment. To insure perfect accuracy and fairness each employé is invited to examine his own record or that of any other employé at any time. He is also at liberty to inspect the scale of marking by which the records are adjusted.

It is evident that a system of bookkeeping resulting from the methods as described would be more expensive to maintain than other forms of discipline which have been generally employed. It has been found, however, that the extra expense attached to this system is trifling in comparison with the results obtained. It has been found by experience in the operations of roads where employés work on a competitive basis that they invariably do their best. They are gentlemanly in their treatment of passengers, neat and tidy in their dress and skillful and prompt in the discharge of their duties. They take great pride in the company's fine equipment, its large business, its management and principles of fair dealing. They never fail to praise the company and its service to patrons, and are only too glad to answer in behalf of the company, an adverse criticism offered by patrons or the public. They feel from the start that their present and future positions in the railway business depend upon the quality of their work, and nothing else.

[1] Read before the American Street Railway Association at Niagara Falls. Abstract.

CONSTRUCTION OF 2½ MILES OF ELECTRIC RAILROAD COMPLETE IN 22 HOURS.

THE New York and Philadelphia Traction Company has been casting about for some time to find some one who could put in two and one-half miles of single track, including grading and overhead construction within twenty-four hours between midnight on Saturday and midnight Sunday. This procedure was deemed necessary in order to prevent the New Brunswick Traction Company from stopping the work by an injunction, as both companies were disputing the territory which was along the eastern road in the township of Bridgewater, N. J., between Bound Brook and Somerville. The New York and Philadelphia Traction Company received no encouragement from any reliable firm of contractors until the matter had been placed by them in the hands of a special committee, which Mr. John Blair McAfee appointed to investigate the matter. Mr. McAfee had a meeting with Mr. C. G. Young, of J. G. White & Company, who had made an inspection of the territory, and on Monday, Oct. 18, in Philadelphia, an arrangement was made by J. G. White & Company to build the work between midnight on Saturday and have a car in operation before midnight on Sunday, Oct. 24.

The work was of such a nature as to require a vast amount of detailed work to be arranged for, as it was absolutely important that not the slightest hitch should occur to the labor work. It was impossible to make any arrangements in Bound

DIGGING THE ROADBED.

Brook or any of the surrounding places for delivery of any of the materials or tools or engagements of men, and it was therefore decided to prosecute the work by operating from special trains.

An arrangement was made with the officials of the B. & O. Railway for a special train for the transportation of two hundred and fifty men, and four cars of tools and provisions from Baltimore; an additional section of six coaches with three hundred Italians was arranged to be added at Philadelphia. All the arrangements had been made with such secrecy that no one had the slightest suspicion of the destination.

In arranging for this Herculean work there were many important things to be considered:

First. To determine the force necessary to accomplish this work within the time named. This was left to Mr. John A. Wilson, superintendent of construction of J. G. White & Company, who had personal charge of the men on this work. Second. The transportation of so large a body of men with tools, appliances, horses, etc. Third. The satisfactory lighting of two and a half miles of roadway in order that the work might be carried on at night as expeditiously as by daylight. The lighting also involved the necessity for special arrangements to have the entire territory lighted within as short a time as possible. Fourth. To provide for the hauling and distribution of the large quantities of material required for the work. This included the hauling of about two hundred and fifty tons of rails, large quantities of ties, poles, etc. Fifth. The providing of shelter and lodging for the army of six hundred.

It must be very gratifying to J. G. White & Company that the entire construction was completed within the time required, and that the details had been so carefully planned as to render this possible even in the face of a terrific wind and rainstorm which raged from Sunday afternoon until Monday morning; and also in the face of the exasperating delays and unlawful arrests of every conceivable nature.

How it Was Done.—The special train left Baltimore at 5.30 Saturday afternoon, with a selected body of men, and the train was put on passenger schedule and but few stops were made. The party was a merry one and much amusement and entertainment was provided by interesting characters among the workmen.

Before the arrival of the train at Bound Brook, timekeepers had gone through the trains and supplied each man with large conspicuous numbers, which were pinned to their hats. This was to avoid any delay in taking time along the lines, as the numbers could be easily read and checked.

The unloading of the train was an interesting sight. First came the unloading of the lighting apparatus, which consisted of a large number of huge Wells flares, which had been shipped on from New York in a special car; these huge lights were placed every six hundred feet along the two and a half miles of the route. Then came the gasoline flares, which were hung every fifty to one hundred feet along the line, and then the lanterns for the army of men; the foremen being supplied with red lanterns to enable them to be easily found. The unloading of all the lighting material was nothing in comparison with the task of filling the lamps and flares, but with a body of willing workers the entire route was fully illuminated within ninety minutes after the arrival of the train.

Next came the unloading of the horses and the tools. This was quickly accomplished and the work of construction was begun at one o'clock Sunday morning. Everything worked on serenely until about two o'clock in the morning, when some men appeared and attempted to serve a copy of what was claimed to be an order to stop work. It was then, however, too late for the serving of papers even had they been legal, and so the work progressed without interruption.

The grading went on marvelously fast, and the plowing teams went through the hard macadam as easily as if it had been soft earth; so rapidly was this part of the work pushed

TRACK LAYING AND BONDING.

that by ten o'clock Sunday morning all of the grading was completed.

Within an hour after beginning the work the track layers had started in, and so fast was the track laid that it was with the greatest difficulty that the fifty teams engaged for hauling rails, etc., could keep the gang supplied. Behind the track layers came the bonders, and as it had been planned to do no temporary work, the bonding was done in the most permanent and substantial manner, using short flexible bonds under the angle plates of the sixty-pound T-rail.

The first men to begin work, however, were the linemen and pole-setting gangs; the overhead construction was divided into sufficient gangs to enable the work to proceed simultaneously over all parts. It was also necessary to build a feeder line about two thousand feet in length connecting what had been a private isolated lighting plant with the railway line; so fast was the line work carried out that all the trolley brackets had been erected by eight o'clock Sunday morning, and at ten o'clock the gangs began the stretching of the trolley wires. The trolley wires were readily run out by the use of the patent reel carts, with braking arrangements, got up by J. G. White & Company. These carts also materially facilitated the erection of the feeder wires.

The location of the camp near the center of the line was specially selected on account of its proximity to a clear stream of water. While the cooks were preparing breakfast, the helpers put up the tents, which consisted of a large wall tent for the commissary department, and two large oval tents with center and side poles, about 50 by 100 feet, for the lodging of the men. Breakfast was served for the first relay of two hundred at about seven o'clock.

All construction moved along rapidly, with no protests until about nine o'clock Sunday morning, when a man named Zeb Van Dorm, whose farm was on a line of the road, issued from his house with a gun which he pointed at the fifty men who were completing the grading in front of his premises; they were Southern negroes, to whom the sight of the gun carried no terror, and when the superintendent demanded Van Dorm to vacate, he used a little argument, and it was with considerable difficulty that the negroes were restrained from taking action. Van Dorm very wisely withdrew and took his gun with him.

The construction went on rapidly, and all was serene until early in the afternoon when the New Brunswick Traction Company had induced the County Commissioners of Bridgewater to make protest and to go with the Sheriff and posse of deputies to the scene, arresting the foremen and others whom they could. Word was passed along the line, and a messenger was dispatched for Mr. Alva A. Clark, the attorney of the New York and Philadelphia Traction Company.

While this was progressing, Superintendent Radel, of the New Brunswick Traction Company, swooped down with a force of one hundred Italians and attempted to tear up the tracks about the center of the construction. When the Baltimore negroes saw this, they made a rush for the crossing, and so desperate was that rush and so terrified were the Italians that they fled in dismay, and they did not stop for fully three-quarters of a mile over the cross country. During this rush a pistol was fired, but it was not known by whom, and no damage was done.

On the arrival of Mr. Clark with Mr. John G. Shaw, a large property holder in the vicinity, the Sheriff had collared about thirty of the foremen, and on demand of Mr. Clark as to what authority he had for their arrest, and the Sheriff admitting that he had no warrant, the men were ordered to go to work, and the deputies and sheriff did not attempt to restrain them.

Sunday night was a terrible night in Jersey and the rain fell in torrents; the wind blew in blasts and it was only by the aid of stimulants that the men passed through the ordeal with nothing worse than lost voices.

Complete secrecy was necessary in obtaining and transporting the trolley car, which was successfully carried out, and the arrangement for power happened to be a very good one. The arrangement for obtaining power was unique. The large hotel property of Mr. John C. Shaw, a prominent New York lawyer, located near Finderne, was used as a power station. This property was equipped with a small isolated plant which had not been in operation for two years; when the rush construction was decided upon, it was found that the boiler would have to be tested, and the engine overhauled. The lighting generator was not suitable, so a railway generator had to be provided, and as it was extremely important that the question of power be absolutely certain, it was thought best to have this plant installed. These changes were made to the plant, and it was put in operation before the eventful Sunday. This was successfully accomplished under the ruse of reopening the hotel, and a new generator was hauled by horses a distance of about sixty miles.

Everything had been so successfully planned and carried out that at 11 o'clock the trolley wires were up and a track opened for the operation of the car. The current was turned on and amid cheers the car was taken over the line, accompanied by a guard, as it was expected an attack would probably be made on the car. This held the franchise and the contract was carried out and the car put in operation in twenty-two hours from the time of beginning the work.

The route for the entire distance lies along the side of the macadamized country road and required at one place the planning and providing of one hundred feet of timber trestling as approaches to a bridge. This was carried on a special train from Baltimore.

The New York and Philadelphia Traction Company are to be congratulated on making their contract with J. G. White & Company, who are also to be congratulated for the successful manner in which the same was carried out. Great credit is due Mr. John Blair McAfee, of the New York and Philadelphia Traction Company, who has shown the greatest executive ability in carrying out his part of the arrangements for the work, and also to Mr. C. G. Young, of J. G. White & Company, who planned the work and made all the detailed arrangements, and to Mr. John A. Wilson, of J. G. White & Company, who superintended the construction of the work.

MR. A. J. CORRIVEAU, of Montreal, and a party of friends took a driving tour of 251 miles recently through the region to be opened up by the Montreal & Southern Counties Electric Railway.

THE STEEL MOTOR CO'.S 50 H. P. STREET CAR MOTOR.

THE success obtained by the Steel Motor Company, of Johnstown, Pa., with their No. 22 motor has led it to follow substantially the same lines in the design of its new No. 34 railway motor of 50 horse-power, which is illustrated in Fig. 1, while Fig. 2 shows it with the lower field open.

The motor is of low carbon cast steel, cylindrical in form, in two sections, with smooth exterior surface, and contains four poles symmetrically located, each provided with its own field coil. All of the working parts are enclosed in the motor frame and are protected from water, grit, etc. Special attention has been given to compactness and the elimination of all surplus or inert material, thus giving a motor of lighter weight for a given output, and of such dimensions that it can be mounted upon any of the standard makes of single or double trucks.

The axle bearing brackets extend over and and rest upon the top of the axle; these together with the armature bearings, caps and suspension lugs are cast integral with the top half of the frame.

Dowel pins secure the correct location of the lower part of the motor when assembled, therefore cored holes and rough bolts only are necessary to fasten together. All of the principal bolts are identical and the removal of four allows the lower half of the motor to swing down by link support from lugs on the upper half. As it swings from the axle, it is readily accessible from the end of the car. By unhooking the link the lower half may be removed entirely, the armature meanwhile being retained in either half of the motor.

By means of oil guards on the armature shaft, which run in open spaces between the motor frame and the armature bearings, all oil, water, etc., is effectually prevented from entering the motor. Access to the motor for the purpose of inspecting the commutator, replacing brushes, etc., is readily obtained through a door on top of the motor frame.

The poles are of laminated wrought iron with serrated face. They are of substantial construction and are bolted into place upon seats bored out in the same operation with the armature bearings, insuring perfect alignment. As each pole is provided with its own field coil, distortion of the field by the armature current is prevented.

The armature is of the well known drum type, built up of Swedish iron laminations between substantial steel heads

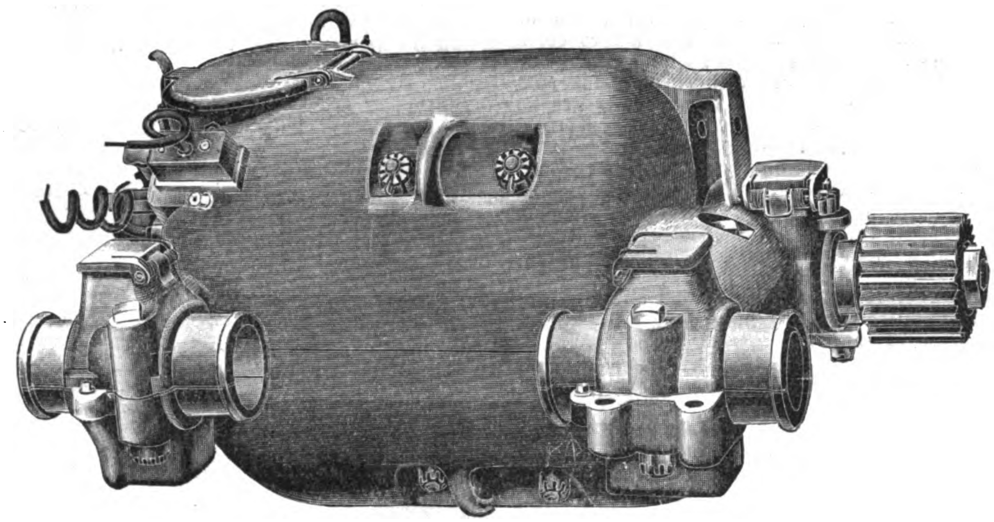


FIG. 1.—STEEL MOTOR CO.'S NEW NO 34 FIFTY-H. P. RAILWAY MOTOR.

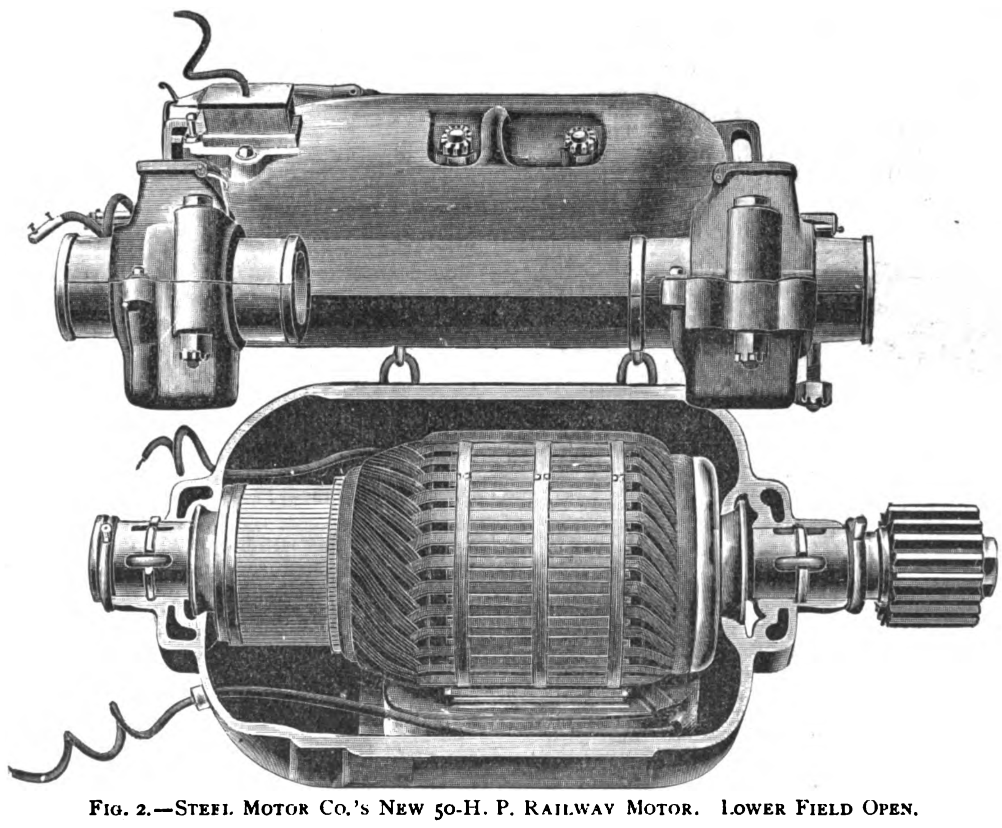


FIG. 2.—STEEL MOTOR CO.'S NEW 50-H. P. RAILWAY MOTOR. LOWER FIELD OPEN.

which have a long bearing on the shaft. The core is hollowed out sufficiently to cut down the distorting effect of the armature on the field of the motor, and also the self induction of the commutating coil of the armature; both tending to eliminate sparking at the brushes, especially at the higher loads. The hollowing out of the core has also the important effect of ventilating and cooling the armature. The core contains but thirty-three slots whic admit of large substantial teeth not easily damaged with rough usage.

The armature winding is exceedingly simple and durable. Three coils are compactly bound together in an armor of special water-proof insulating material, and pressed to form and size in steam presses; making practically one coil. The entire winding consists of thirty-three of these coils inserted in an equal number of slots in the core. The heads are so disposed that perfect ventilation of the winding is secured and but few coils are disturbed in making repairs.

The commutator is of the undercut bar type. An ear thrown up at the rear end is milled to receive the armature leads, which are tightly driven to place and swaged to secure perfect contact. Both the slots and the ends of leads are tinned to prevent corrosion, but no solder is used or required to effect electrical connection.

The insulation of the commutator is mica throughout, and the usual methods are supplemented by insulating the commutator shell from the armature shaft.

The field coils are made interchangeable and are wound on insulated metal spools accurately fitted to and held in place by the pole pieces.

The brush holders are interchangeable. Blocks of insulating material are permanently bolted to the motor frame upon which the brush holders are attached. Adjustment to compensate for the wear of the commutator, is effected by sliding the holder upon the insulating block. No other adjustment is necessary and there is no possibility of derangement. The brush holders and brushes may be removed and replaced without opening the motor. Pressure is imparted to the brush by a coil spring and a spring lever, the arrangement of which insures a uniform tension at all times. Electrical connection is by flexible cables brought out through the frame of the motor.

The axle and armature bearings are cast iron shells lined with babbitt.

The motor is arranged for either nose or side-bar suspension, the first by means of a straight bar bolted to the motor, the ends of which are supported on springs attached to the side bars of the truck. With the side-bar suspension the motors are supported at their center of gravity, relieving the axle of all dead weight and neutralizing the effect of the inertia blow upon the track.

The axle gear is of cast steel and the pinion of hammered steel, both having teeth cut from the solid metal. The pinion fits a tapered seat on the armature shaft. Both are enclosed in a malleable iron casing which is provided with an opening for admitting lubricants.

NEWS AND NOTES

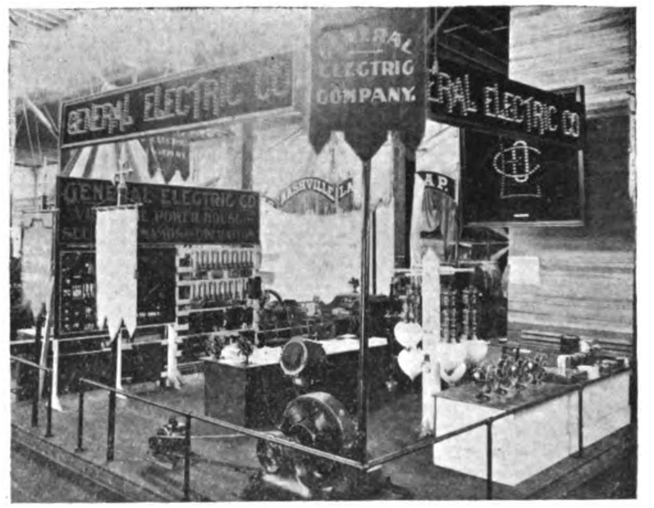
GENERAL ELECTRIC EXHIBIT AT THE NASHVILLE EXPOSITION.

An interesting exhibit of electrical machinery has been made by the General Electric Company at the Tennessee Centennial Exposition, at Nashville, Tenn. The stationary portion occupies a prominent position in the center of Machinery Hall, with an aisle on three sides. A purely industrial exhibit, it is devoid of any of the spectacular features which served to ornament the exhibit made by the same company at the World's Fair. It is almost entirely confined to electric lighting apparatus, and comprises meters for station and portable use; a line of the type H transformers, ranging from the small one of 600 watts capacity up to that with a capacity of 30,000 watts; arc lamps of different types for direct and alternating current work, open and enclosed, and for arc series circuits; lightning arresters of the Wirt short gap type. In the center of the exhibit stands a one horse-power single phase induction belted to and driving a 75-ampere four-pole slow speed direct current dynamo. Samples of the wire manufactured by the company occupy two glass cases and cover a wide range of output—from the small incandescent lamp cord to the heavy submarine cables and sections of tubing carrying conductors from 300,000 to 750,000 circular mils. A full line of wiring appliances of all kinds is also exhibited.

The exhibition space is illuminated by two signs and a monogram in miniature incandescent lamps on black velvet covered boards; and during the heated terms it was kept agreeably cool by breezes created by a number of small 1897 motor fans. A large searchlight has proved an attractive feature of the exhibit, as the majority of visitors, while having heard of such an instrument have never before had the opportunity of examining one and of seeing it operate.

In the power house, however, the main exhibit of the General Electric Company's apparatus is made. There several machines are shown in operation representative of the different classes it manufactured. The single-phase alternating current system is represented by six 125 cycle alternators, each of 120 kilowatt capacity. These machines carry the entire load of lights used for decorative purposes—about 15,000, as well as a heavy load of induction motors scattered throughout the exhibition buildings. There are also two Brush arc generators, each having a capacity of 125 lights. These machines are run with multi-circuit connection, that is, their separate circuits are run from each machine. These supply current to 250 Brush arc lamps in the grounds. In the electrical equipment of the Tennessee Centennial Exposition, besides the machinery plants mentioned, the General Electric Company has installed nearly all the transformers employed, 25 of 1,500 watts, 20 of 2,500 watts, 20 of 3,000 watts, 4 of 7,500 watts and 10 of 15,000 watts, all of the type H.

The Exposition closed on Saturday night last.



GENERAL ELECTRIC CO.'S EXHIBIT AT THE NASHVILLE EXPOSITION.

SOCIETY & CLUB NOTES

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the Institute, held October 27, a paper was presented by Mr. Richard Lamb on the "Development of Electric Cableways," describing the use of the electric motor for logging and canal boat haulage. It was fully illustrated by lantern slides. The paper was discussed by Messrs. Bijur, Henshaw, Steinmetz, Keith, Leonard, Mailloux, Ries, Martin, Sachs and Wolcott. About 75 members and guests were present.

At the meeting of the Executive Committee in the afternoon the following associate members were elected:

Balsley, Abe, chief electrician, Terre Haute Electric Railway Co., 514 No. 6½ street, Terre Haute, Ind. Balcome, Herbert A., the Eddy Electrical Manufacturing Co., Windsor, Conn Child, Chas. T., editor the "Electrical World," 253 Broadway, New York. Goltz, William, Hathaway Building, Milwaukee, Wis. Jones, M. E., contractor and student in senior class, Cornell University, Ithaca, N. Y. Le Clear, Gifford, electrical and mechanical engineer, partner Densmore & Le Clear, 7 Exchange Place, Boston, Mass.; residence, Cambridge, Mass. Thompson, Silvanus P., Morland, Chislett Road, West Hamp-

stead, London, N. W., England. Williams, Geo. Henry, district superintendent the Edison & Swan United Electric Co., Ltd., 134 Royal avenue; residence, Culmore, Glenburn Park, Belfast, Ireland. Wotton, James A., electrician Southern Bell Telephone and Telegraph Co., P. O. box 218, Atlanta, Ga.

The following associate members were transferred to full membership: Sampson, F. D., manager Charlotte Electric Light and Power Co., Charlotte, N. C. Davidson, A., cable engineer and electrician, Central and South American Telegraph Co., Lima, Peru. Decker, Edward P., electrical engineer, New York Telephone Co., 18 Cortlandt street, New York.

THE WESTERN ELECTRIC GIRLS' OCCIDENT CLUB.

The Western Electric Company have provided two large rooms for the girls employed in their Chicago factory. These girls have formed a club called the Occidental Club, which has now been in existence for two years. It is self-supporting and entirely managed by the girls themselves. They have fitted up the rooms which have been furnished them by the Company, one as a library and reading room, which is also used as a room for concerts, and has a seating capacity of about 500; the other, which is of the same size, has been fitted up with lunch counters and a kitchen.

On Saturday, the 16th, the Occident Club gave a literary and musical entertainment from 4:30 to 5:30 and from 5:30 to 6:30 furnished refreshments. The rest of the evening was spent in a social way. Over 400 attended the entertainment.

LEGAL NOTES

PLANTS DESTROYED BY ESCAPING GAS.

An action brought by W. H. Siebrecht against the East River Gas Co., in which judgment recovered on the trial by the plaintiff has been affirmed by the New York Second Appellate Division, presents some singular features. The plaintiff, a florist who owns greenhouses in Astoria, Long Island City, claimed damages because the company allowed a pipe laid in the ground near his premises to become out of repair, so that gas escaped and destroyed his flowers and plants. The pipe ran along the tracks of an electric railway. The ground in the winter was frozen to quite a depth, so that the escaping gas was prevented by the frozen crust from reaching the surface, and in consequence percolated through the soil and entered the greenhouses. It was claimed for the company that the life of the pipe, according to experts, had not expired and that its condition was produced by the action of the electrical current from the railroad, which produced electrolytical action. This action, defendant asserted, was not understood by scientific men, and the company was without knowledge of it. Having remedied the defect as soon as possible, it claimed not to have been guilty of negligence. Justice Hatch, who gave the unanimous opinion of the court, said in concluding his opinion: "The jury saw the pipe, heard the testimony, and they could well have said that its condition was produced from lying in a wet place. The character of the place should have been known, for the defendant made the excavation and laid the pipe therein. This evidence is more than a scintilla; it had substance in it, and the jury were authorized to predicate negligence of the defendant for a failure to examine the pipe under such circumstances. The evidence was clearly sufficient to exonerate the plaintiff from contributory negligence, and this question requires no discussion at our hands."

THE CAPITAL TRACTION COMPANY TO ADOPT THE SUB-TROLLEY IN WASHINGTON.

The Capital Traction Company, of Washington, whose million-dollar plant, consisting of power house and machinery, was burned recently, has decided to substitute the underground electric trolley system for the cable power, by which for the last four years the avenue and 14th street lines of the road have been operated. It was also practically decided not to rebuild upon the old site.

INVENTORS' RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED OCTOBER 26, 1897.

Alarms and Signals:—

ELECTRIC VIBRATING BELL. H. F. Albright, Elizabeth, N. J., 592,269. Filed July 11, 1896.
The circuit breaking mechanism and magnets are enclosed in water-proof case, the armature being placed outside.

CUTOUT FOR ELECTRIC SIGNAL BOXES. L. W. Miller, Rochester, Pa., 592,427. Filed Sept. 29, 1896.
Designed to prevent the closing of the door and cutting the instrument out of circuit by means of a supplemental lock arranged to automatically eject its bolt when the door is opened.

AUTOMATIC ELECTRIC ALARM DEVICE. P. V. Vandevelde, Corona, N. Y., 592,503. Filed July 26, 1897.
For use in connection with window sashes provided with counterbalance weights.

Batteries, Secondary:—

ELECTRIC BATTERY. F. M. Bell, New York, 592,722. Filed May 18, 1896.
Comprises a negative plate formed of a lead grid filled with peroxid of lead and provided with a perforated protecting covering of insulating material and amalgamated zinc positive plates suspended on opposite sides of the negative plate, being immersed in an electrolyte.

Conductors, Conduits and Insulators:—

ELECTRIC CABLE. W. R. Patterson, Chicago, Ill., 592,441. Filed Aug. 20, 1896.
A flat cable, consisting of insulating wires wound spirally about a central metallic ribbon. The metallic ribbon having substantially the rigidity and flexibility of copper.

ELECTRICAL INSULATOR. W. Barbour, Bar Harbor, Me., 592,505. Filed Aug. 28, 1897.
Comprises an inner cylinder of glass, provided with an internal screw, and external projections, and an outer covering of elastic material provided with a groove.

ELECTRIC CONDUCTOR. G. Gray, Boston, Mass., 592,703. Filed Dec. 4, 1896.
Comprises a continuous core and an outer portion divided by longitudinally and annularly extending grooves, the core being of material harder than that of the outer portion.

Dynamos and Motors:—

ELECTRICAL POWER TRANSMISSION. T. J. Fay, Brooklyn, N. Y., 592,244. Filed Feb. 12, 1897.
Comprises a machine with a hermetically sealed casing, an electric motor whose armature is stationary, and placed outside the casing and whose field magnets revolve and are placed within the casing and connected to the machine.

SUPPORT FOR ARMATURE SHAFTS. W. R. Thompson, South Norwalk, Conn., 592,502. Filed April 26, 1897.
Comprises a yoke secured to the armature shaft supports, a tubular screw threaded shaft passing through the yoke, and a supplemental spring operated shaft passing thereinto, and adapted to bear on the armature shaft.

Lamps and Appurtenances:—

INCANDESCENT ELECTRIC LIGHT SUPPORT. R. L. Mahon, Duluth, Minn., 592,551. Filed July 17, 1896.
Comprises a rod, a collar rotatably mounted thereon, spring-clips carried by the collar, and an incandescent lamp supported in the spring clips.

Miscellaneous:—

ELECTRIC EQUIPMENT FOR VEHICLES. S. H. Short, Cleveland, Ohio, 592,259. Filed Aug. 27, 1896.
Apparatus adapted and carried by the vehicle for generating and supplying a current of electricity for the driving motor, lighting or signaling apparatus.

APPARATUS FOR ELECTRICALLY TREATING LIQUIDS. F. Jones, Chicago, Ill., 592,735. Filed Feb. 23, 1897.
Consists of a receptacle having equidistant sinusoidal electric conducting sides, a non-conducting bottom and pieces separating the sides.

Railways and Appliances:—

SUPPLY SYSTEM FOR ELECTRIC RAILWAYS. A. Megroz, Buda Pesth, Austria, Hungary, 592,524. Filed April 13, 1896.
Conduit system.

ELECTRIC RAILWAY. L. E. C. Crocker, Bridgeport, Conn., 592,528. Filed March 1, 1897.
Third rail system in which the third rail is laid between the other two.

JOINT FOR THIRD RAIL FOR ELECTRIC RAILWAYS. P. Haley and P. P. Thompson, Chicago, Ill., 592,565. Filed March 22, 1897.
Comprises plates adapted to close the bottom and sides of the joint, and a good conductor filled in between the ends of the rails held by the plates.

CONTACT DEVICE FOR ELECTRIC RAILWAYS. E. R. Pommer, New York, 592,596. Filed Nov. 20, 1888.
Comprises a trolley pivoted on an axis longitudinal to the car and a support for the longitudinal axis pivoted to an axis transverse to the car, and having a weighted lower end to take the place of springs.

CONDUIT RAILWAY TROLLEY. W. Luer, Chicago, Ill., 592,711. Filed Jan. 4, 1896.
Comprises adjustable contact blocks supported by rods and means for regulating the contact between the blocks and the conductors.

Regulation:—

ELECTRIC MOTOR REGULATOR. F. Vidal, Y. Vilaret and D. Belais, New York, 592,619. Filed May 24, 1897.
Comprises a variable resistance in series circuit with the field,

means for automatically and gradually reducing the resistance, and breaking the circuit upon a definite increase in its current strength.

Switches, Cut-Outs, Etc.:—

FACE PLATE FOR FLUSH SWITCHES. G. W. Hart, Hartford, Conn., 592,249. Filed Nov. 5, 1896.
Details of construction.

AUTOMATIC ELECTRIC CIRCUIT BREAKER AND CLOSER. E. Fruckner and George Schindler, Newark, N. J., 592,443. Filed Feb. 4, 1897.
Means for opening the circuit and cutting off connections between the secondary battery and the generator in a lighting system in case of accident.

CEILING BLOCK. T. C. Swinnerton, Bridgeport, Conn., 592,482. Filed Nov. 2, 1896.
Method of wiring.

CONTACT IN SHUNT FOR CIRCUIT BREAKERS. W. M. Scott, Philadelphia, Pa., 592,497. Filed May 1, 1897.
Comprises main contacts, carbon contacts in shunt for final separation with metal plates yieldingly attached to the carbons, each carbon and the plate attached adapted to form a jaw to receive the opposite contacting carbon and hold it in close contact.

THERMOMETRIC ELECTRICAL CIRCUIT CLOSER. G. H. Zeal, London, Eng., 592,600. Filed May 10, 1897.
Details of construction.

ELECTRICAL RESISTANCE DEVICE. E. E. Anthony, Detroit, Mich., 592,463. Filed Feb. 23, 1897.
Composed of a concentric series of polygonal resistance coils supported upon a reel, insulated from each other and a sliding spring jack in frictional adjustable contact between each pair of coils.

Telegraphs:—

TELEGRAPH TRANSMITTER FOR OCEAN CABLES. D. Lynch, New York, 592,494. Filed March 16, 1895.
Comprises magnets for closing currents in the line in opposite directions, local batteries in circuit with the magnets, circuit closers for short circuiting the magnets, and means for automatically opening and closing the circuit closers at predetermined intervals.

Telephones:—

MULTIPLE SWITCHBOARD. M. G. Kellogg, Chicago, Ill., 592,301 to 592,415, inclusive.
Details relating to construction of multiple telephone switchboards.

SPRING JACK FOR TELEPHONE SWITCHBOARDS. M. G. Kellogg, Chicago, Ill., 592,416. Filed April 1, 1893.
Improvement on inventor's previous patent, No. 308,315. Refers to test system for metallic circuits.

MULTIPLE SWITCHBOARD. M. G. Kellogg, Chicago, Ill., 592,417 to 592,425, inclusive.
Details relating to construction of multiple telephone switchboards.

TELEPHONE SWITCHBOARD APPARATUS. F. R. McBerty, Downer's Grove, Ill., 592,431. Filed Sept. 25, 1896.
Means for preventing the operation of the line annunciator by the clearing out signal.

CUT-OFF RELAY FOR TELEPHONE SWITCHBOARDS. F. R. McBerty, Downer's Grove, Ill., 592,432. Filed March 11, 1897.
Details of construction.

PILOT LAMP FOR TELEPHONE SWITCHBOARDS. C. E. Scribner, Chicago, Ill., 592,452. Filed March 11, 1897.
Means to eliminate the resistance of the magnet of the pilot controlling relay, from the circuit of the lamps during their display.

THE STOCK MARKET

STOCK MARKET CONDITIONS IMPROVING.

With a little slackening in the demand for staple merchandise, there has also been a lull in the stock market, but very few unfavorable or adverse conditions exist that might prejudice trade. Wheat has again passed the dollar mark, and the exports of it are heavy. Moreover, the consumption of iron and steel continues very large, and mills are said to be refusing orders for 1898 delivery on the ground that prices will be higher. The money market has been easy, although no special influx of gold has occurred, as it is understood Europe is borrowing on this side.

Western Union Telegraph sold last week around 88 on only 6,819 shares. Of General Electric, the sales were 4,575 shares, down to 33¾; and on a few hundred shares Bell Telephone stood at about 260. New York Edison is firm around 123.

Copper is quoted at 11 cents, and lead at 3.90. Steel rails are $20.50 to $22.50.

SOUTH NORWALK, CONN.—At a special meeting of citizens last week it was voted to establish a commercial electric lighting system in conjunction with the plant already in existence, and $20,000 was appropriated for the purpose. Mr. A. E. Winchester will probably be the engineer and give his whole time to it. He has been one of the commissioners in charge of the plant for simple street lighting.

ASTORIA HOTEL. The Postal Telegraph Company has obtained a lease for an office in the new Astoria Hotel, and it is said that this has been done in spite of opposition from the Western Union, which has always insisted on exclusive hotel privileges. The Postal people are also in the Hoffman.

TRADE NOTES & NOVELTIES

ACTIVITY OF THE WALKER CO.

The Walker Company has two busy shops these days at Cleveland and New Haven, and a glance through the various departments from draughting room to assembling shop would show many machines of many types in process of construction to fill contracts on hand. The largest work in hand in this, or perhaps in any other shop at present, consists in building the two 1,600 k. w. direct connected generators for the Brooklyn Heights Railroad, but this undertaking does not prevent active work on some of the smaller machines. Two 225 k. w. direct connected generators are being built for the Meadville, Pa., Traction Company, and in addition to the generators and the station switchboard this road will use eight double street car equipments of the Walker 4 A, 25 h. p. type. Five other railway generators are in process of construction for the Paris tramways, three 200 k. w. of the belted type and two 300 k. w. direct connected.

In addition to these railway generators the Walker Company is engaged in manufacturing three electrical locomotives for Western copper mines. One of these is for a standard gauge track and the other two for a narrow three-foot gauge. In designing and building narrow gauge motor units of whatever nature the success of the Walker Company is shown conclusively by the large number of American and foreign orders for machines of this class filled during the past year.

Among the isolated plants by the Walker Company now in progress may be mentioned one at the St. Lawrence State Hospital, near Ogdensburg, N. Y., where the plant will consist of six direct connected generators, two each of 25, 50 and 75 k. w. capacity respectively, besides a very complete switchboard. The R. G. Dun building, now being erected at the northeast corner of Broadway and Reade streets, New York, will be lighted by three 100 k. w. direct connected Walker generators; and plants are to be placed in the Girard building, Philadelphia (200 k. w. d. c. Walker generator) and in the new Wellington Hotel, Milwaukee, where two 150 k. w. machines will supply the light. Orders for over 125 equipments for European street railways are being filled, among them being one for the Ghent tramway, Belgium. The Bellaire Steel Company, of Bellaire, Ohio, whose power plant consists of two 100 k. w. direct connected Walker generators, is about to more than double its capacity by the addition of a direct connected 250 k. w. machine.

It will be seen from these facts that Walker apparatus enjoys the widest popularity, nor is the company backward in the design and manufacture of the more recent types of alternating machines, including generators of multiphase currents and rotary transformers.

THE BOILER EXPURGATOR.

There is probably no greater annoyance with which the practical engineer has to deal than boiler scale. The presence of scale or sediment in a boiler results in loss of fuel, burning and cracking of the boiler, predisposition to expansion and necessitates constant repairs. It is estimated that the presence of one-sixteenth of an inch of scale causes a loss of 13 per cent. of fuel; one-fourth inch, 38 per cent.; and one-half inch 60 per cent.

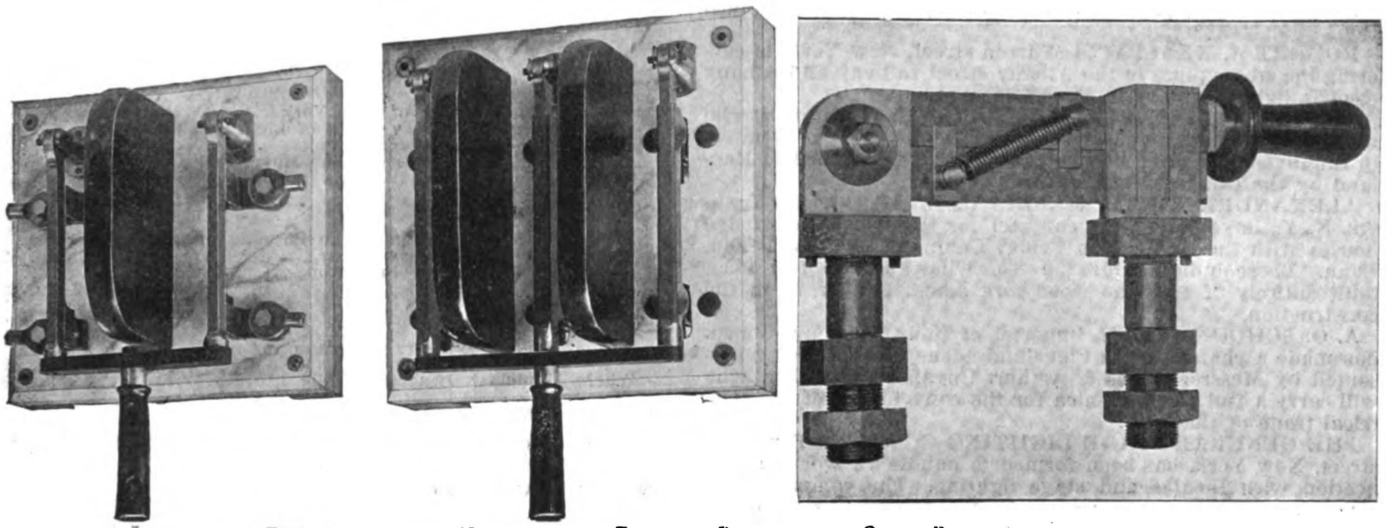
The boiler expurgator offered by the Boiler Expurgator Company, of 115 Dearborn street, Chicago, is designed to prevent entirely the formation of scale. The expurgator is put up in rolls or sticks. After the boiler has been washed a stick of the expurgator is placed in the boiler and dissolves as soon as the water boils; the grains of the stick are carried in suspension in the water and disappear by attrition in about thirty days.

The use of the expurgator prevents the mud from baking, thus preventing the burning of the boiler tubes and sheets. A little pamphlet issued by the Boiler Expurgator Company contains a number of very flattering testimonials as to the efficiency of their product, from users. The same company are also sole selling agents for the Holm Tesoline commutator compound.

SPRAGUE ELECTRIC ELEVATOR CO., Postal Telegraph building, are feeling very happy in securing after a long fight the order from W. W. Astor for nine elevators to go in the immense Exchange Court building near Wall street. The award of this order, Mr. C. A. Benton says, is but one sign of the strong drift of business to the Sprague system.

NEW G. E. BARRIER SWITCHES.

OF the switches used by the General Electric Company upon the alternating current switchboards manufactured at its works in Schenectady, one is the double break switch, commonly called the T-H. This has recently been improved by placing barriers between the blades, making it satisfactory for use on circuits with a potential up to 2,300 volts. The other is the so-called "safety" switch, which has the contacts on the back of the panel, while the blades are on the front. When this switch is closed the blades pass through holes in the marble and enter contacts. Barriers are also placed between the blades of this switch. The blades are also insulated from the metal back which holds them. Thus, when closed, no current-carrying part of the switch is exposed and the chance of shock becomes almost impossible. For higher voltages and inductive leads, the switchboards being special, specially designed switches are constructed to meet the requirements of the case. Figs. 1 and 2 show the T-H and safety switch respectively, with barriers. The quick break switches for use on circuits of nominal 500 volts, also manufactured by this company, are constructed with a view to obtain the greatest accuracy. The switch blade contact consists of two pieces laid edge to edge, and connected to a common hinge. They are also connected by a pair of spiral springs, one on each side. Both sections of the blade make connection with the contact clip, as shown in Fig. 3.



FIGS. 1, 2 AND 3.—NEW GENERAL ELECTRIC BARRIER AND QUICK BREAK SWITCHES.

In opening the switch the outer section of the blade, to which the insulated handle is attached, is withdrawn to an angle of 30 degs. before the inner section moves. The inner half of the blade then begins to move, forced from the clip by positive action; as it leaves the clip it is drawn smartly up to the outer half of the blade by the action of the tension springs. The result is an extremely quick break and a wide gap, over which an arc cannot hold. Switches of this type are made in capacities from 50 to 5,000 amperes at 750 volts, are constructed for both single and double throw, with or without bases, with either front or back connections, except with the 1,800, 3,600 and 5,000 ampere switches, which are not furnished with bases unless on special order.

Single pole switches, three point, four point, etc., are also manufactured by the General Electric Company, and are of great convenience in many cases. They swivel at the hinge connection and may control any reasonable number of circuits. Like the standard switches, they are built with bases, or back connections for switchboards as desired. The base of the 50 ampere switch is of porcelain; that of the larger sizes is of slate.

THE ELECTRIC ARC LIGHT CO. have removed their offices from 667-669 Broadway to the American Tract Society Building, 150 Nassau street, where they will be pleased to see all their friends. William C. Hubbard has been elected secretary and general sales agent of the company and will have charge of the new office. Mr. Hubbard is a pioneer in the enclosed arc business, having been associated with Prof. L. B. Marks from the first experiments along that line and assisted largely in the introduction of the "Pioneer" arc lamp.

ADVERTISERS' HINTS

THE WESTINGHOUSE MACHINE CO., Pittsburg, Pa., have received an order from the Metropolitan Electric Supply Co., of London, England, for the entire equipment of a new lighting station with Westinghouse apparatus, the power for which will be supplied by three Westinghouse engines of the vertical compound-marine type of 2,500 h. p. each.

THE WALKER COMPANY set forth the merits of their brush holder. They are well worth considering.

THE BOILER EXPURGATOR CO., 115 Dearborn street, Chicago, are the sole selling agents of Holm's commutator compound. They will send free samples and will return the money on sales should it not prove as guaranteed.

WILLIAM CURTIS THAYER, 30 South Water street, Cleveland, Ohio, may be consulted on all electrical engineering matters.

THE AMERICAN ENGINE CO., Bound Brook, N. J., state the advantages of their direct connected plants.

THE HART & HEGEMAN MANUFACTURING CO., Hartford, Conn., announce recent radical changes which have added greatly to the superiority of the Hart switches. Their "knife switch" form of contact and patent self-adjusting, dust-proof handle are two of many good points which must meet with the user's approval.

A. A. McCREARY, 136 Liberty street, New York, is now ready with a new list of discounts on his standard reflectors in both silver and green bronze finish. He states there are 900,000 in use.

THE ANCHOR ELECTRIC CO., 71 Federal street Boston, Mass., advertise electro-mechanical gongs, both single stroke or continuous ringing, for open or closed circuit.

THE POTOMAC TERRA COTTA CO., 36 Corcoran Building, Washington, D. C., are supplying conduit for underground electric wires.

THE MASSACHUSETTS CHEMICAL CO., Boston, Mass., make a specialty of the insulation of armatures and fields.

THE S. S. WHITE DENTAL MANUFACTURING CO., Philadelphia, advertise the Partz acid gravity battery for all open circuit work, and Partz sulpho-chromic salt as affording the best, cleanest and most convenient method of making electropoion fluid for medical batteries, Grenet cells, etc.

THE WHEELER REFLECTOR CO., Boston, Mass., offer tin shades in 136 electric styles for arc and incandescent lighting and at the lowest prices.

THE COX THERMO ELECTRIC CO., LTD., 126 Liberty street, New York, have recently brought out a small 1.3 volt. 3 ampere generator, using either gas or alcohol. It is sold complete with burner, stand and connections for $5 cash.

THE STANDARD AIR-BRAKE CO., 100 Broadway, New York, note the great increase in air-brakes on the B. & O. freight cars, and suggest that it is far more important that street railways should increase the number of cars similarly equipped.

THE CLINTON WIRE CLOTH CO., Clinton, Mass., manufacture wire cloth and perforated metals for use in dynamos and motors, the principal utilization being the protection of the commutator.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, are in business to supply the electrical trade with the greatest amount of the best supplies at the least possible price.

EDWARD P. THOMPSON, Temple Court, New York City, refers to many well known clients and invites inquirers from interested parties.

THE NEW YORK TELEPHONE CO. have now over 20,500 telephone stations in New York City. The number is constantly increasing.

NEW YORK NOTES.

MR. NELSON W. PERRY, M. E., has resigned from the editorship of "Electricity" and become associated with the Westinghouse steam engineering interests, his new address being 604 Havemeyer building. His able pen will still be devoted once in a while to the discussion of technical topics.

MR. STUART W. WISE, president of the Puritan Electric Company, has removed their offices to the Bowling Green building, Broadway, where they have greatly increased facilities for handling the alternating enclosed arc, which they make. The change was rendered necessary by the large increase in business this fall, which is taxing their facilities of production to the utmost.

THE S. & B. ELECTRIC CO., 70 Fulton stret, New York, have issued a new catalogue of electric supplies, novelties, etc., and will take pleasure in mailing it to any address on application.

ROBERT A. KEASBY, 54 Warren street, New York, is covering the steam pipes in the Albany street railway and Albany electric light plants with magnesia covering.

MESSRS. ROBERT BLACKWELL and H. F. Parshall, who have been spending some weeks in this, their native country, in the investigation of electric railway work, returned to England by the Cunarder last Saturday.

ALEXANDER SMITH & SONS CARPET CO., of Yonkers, N. Y., have placed the contract for the two fireproof dye houses with the Berlin Iron Bridge Company, of East Berlin, Conn. These buildings are 50 feet wide and 100 feet long, built entirely of steel, no woodwork being used at all in the construction.

A. O. SCHOONMAKER, importer of India and amber mica, has made a change in his Cleveland agency, being now represented by Messrs. Hayes & Arthur, Cuyahoga Building, who will carry a full stock of mica for the convenience of the electrical trade of that city.

THE GENERAL STAGE LIGHTING CO., of 215 East 50th street, New York, has been formed to handle all work in connection with theatre and stage lighting. The company will also take agencies for any novelties in the electrical line. At present the company is lighting several New York theatres and has equipped many road shows. They are now rehearsing the Venus Statue Dance, which has a number of new electrical effects. Mr. Humphrey D. Davy, the general manager of the company, has had extensive experience in the work in which the company has engaged.

MESSRS. OSTERBERG & SUTTON have been retained as consulting electrical engineers for the Cushman Building, now being erected by the Cushman estate at the corner of Broadway and Maiden Lane, New York. The building will have a complete electric light and elevator plant, for which Messrs. Osterberg & Sutton are now drawing up plans and specifications.

EDWARDS & CO., Fourth avenue and 144th street, New York, are booking good orders for their duplex bell for street crossings in connection with both trolley and steam railroads.

"RAINBOW" is the name and rainbow is the style of the literature of the Peerless Rubber Manufacturing Co., 16 Warren street, New York City. Their packing is always highly popular where steam is being generated or circulated.

H. M. SHAW & CO., 136 Liberty street, New York City, report receiving good orders on the whole line of their specialties, viz.: Partridge self-lubricating carbons, woven wire gauze, copper leaf, Brush and T. H. arc and "Wirt" brushes.

WESTERN NOTES

THE ELECTRIC APPLIANCE CO. report that they are rapidly reaping the benefits of the complete distribution of their new issue of general catalogue No. 12, and that it is resulting in a very large increase in their business and the opening up of a great many new and desirable accounts. The Electric Appliance Company are certainly entitled to reap their reward, as the catalogue issued is a very elaborate one and has been published and distributed only at a very great expense.

MR. A. McNAB LITTLE has accepted a position as traveling salesman for the Western Electric Company, of Chicago.

MR. G. W. PATTERSON, Marquette Building, Chicago, general Western agent for various lines of electrical supplies, has issued a neat little card with interesting diagrams showing the periods when to make money. Now is one of them.

W. H. ELLIOTT ELECTRIC CO., of Cleveland, Ohio, have recently acquired the agency of the Fostoria Incandescent Lamp Company for Northern Ohio.

MR. W. D. PACKARD, of the New York and Ohio Company, of Warren, Ohio, was a caller at this office this week and advised us that he had completed arrangements by which Messrs. Schiff, Jordan & Co., of 232 Greenwich street, New York, would represent the Packard lamp in New York and vicinity and would hereafter carry an ample stock in their warehouse for prompt delivery.

MR. GILBERT WILKES, of Detroit, was a visitor in New York last week. He is busily engaged with expert work, especially in the steam engineering field.

MR. L. A. FERGUSON, the electrical engineer of the Chicago Edison Company, was East last week on work for that corporation.

JENNEY ELECTRIC CO., of Indianapolis, C. D. Jenney, president, has decided to start up a new factory soon in Detroit as a good center for motor work.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. NOVEMBER 11, 1897. No. 497.

ELECTRIC LIGHTING

THE DE LAVAL HIGH-PRESSURE STEAM TURBINES AT THE STOCKHOLM EXHIBITION.

ONE of the most interesting and technically important exhibits at the Stockholm Exhibition is the high pressure steam turbine and boiler plant, furnishing electric light for the entire exhibition. The electric station consists of four groups of 100 horse-power and two of 50 horse-power each. Each group consists of a boiler and a steam turbine dynamo unit, and a condenser, together with the necessary regulating apparatus. The station itself is illustrated in the accompanying engraving, Fig. 1, taken from "La Nature," and shows one of the groups complete in one of the corners. The most remarkable feature of this plant is that it operates at a steam pressure of no less than 220 atmospheres, or 3,234 pounds to the square inch. To work at such a high pressure, of course, requires special constructions and these have been worked out in a most admirable manner in the apparatus illustrated. Besides this, the automatic regulation is also worthy of special mention.

The steam generator proper consists of a continuous tube, into one extremity of which steam is injected and from which steam escapes at the other end. The vaporizing tube has a cylindrical section about 1 or 1¼-inch internal diameter and forms a series of concentric coils around the central pipe, through which the coal is charged. The whole is comprised within the annular space of a sheet iron cylinder lined internally with material for preventing heat radiation. At the bottom of the coal hopper is an arrangement which facilitates the continuous renewal of the coal and the cleaning of the grate. This consists of a cone of refractory material which is kept in constant rotation. Between the grate and the carbon there is a coil of the boiler tube which thus acts as a scraper, and maintains the grate constantly clean. The boiler is furnished with regulators for the feed water and for the draft, and their working is based on the action of pistons balanced by the pressure of steam on one side and water pressure and springs on the other.

Fig. 2 shows diagrammatically the complete installation of the boiler, turbine, condenser and accessory apparatus of the De Laval system. The coal which is fed from above falls on the cone a_7 and fills the pipe a_2, which is then closed. The reservoir B_4, as well as a part of the coil is filled with water. As soon as the fire is lighted, steam is generated in a_1 and penetrates, by the regulators D, and the spouts c_1, c_2, c_3 and c_4 to the turbine C, which begins to turn faster and faster as the pressure increases.

The apparatus E, which is completely open, and into which the water—coming in a loop from the feed pumps G through the intermediary of the apparatus H—circulated freely, now begins to close by the action of the turbine governor. The pressure of this water, thus intercepted, increases progressively in the apparatus D. In adding itself to the action of the springs, which are of unequal strength and progressively decreasing, this pressure closes the openings one after the other, and permits the passage of the steam to the turbine spouts.

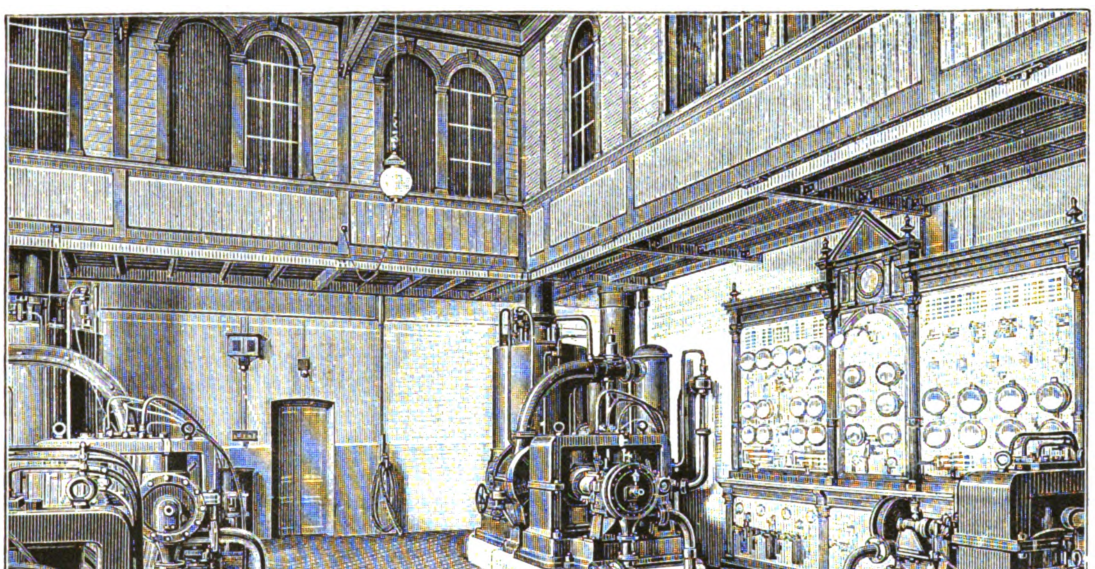


FIG. 1.—DE LAVAL HIGH PRESSURE STEAM TURBINE ELECTRIC LIGHT PLANT, STOCKHOLM EXPOSITION.

The following operations take place automatically: The coal descends to the grate, being carried along by the rotating movement of the latter. The apparatus K, under the action of the steam, operates the dampers a_4, a_5, and a_6, which allow the air to enter, blown by the turbine. The feed pump G is driven by the turbine itself, which also drives a centrifugal pump connected directly to one of the shafts, and which feeds the condenser B.

As soon as the machine is charged, the governor opens the apparatus E a trifle, and the water loses some of its pressure. The pistons of the apparatus D recede, and allow the steam to pass in quantity sufficient for the work demanded of the turbine.

The steam under pressure, which may go as high as 220 atmospheres (corresponding to a temperature of 375 degrees C), arrives at the spouts in which it expands completely up to the

pressure of the condenser before being projected against the buckets of the turbine. After having done its work, the steam goes to the surface condenser B, and after condensation is transferred by the pump F into the reservoir b_4 and from there again taken by the feed pump G to be transferred to the generating coil of the boiler.

The centrifugal pump, connected to one of the auxiliary shafts of the turbine, furnishes water under pressure in a sort of ejector b_2, which communicates with the space b_1, where the steam is condensed, and thus entrains the air contained in it. After passing through the ejector, this water is led into the condenser from below to the top, and from there out. The centrifugal pump thus performs the function of a circulating as well as an air pump. The apparatus H, branched from the feed pipe, in which there is a greater pressure than that of

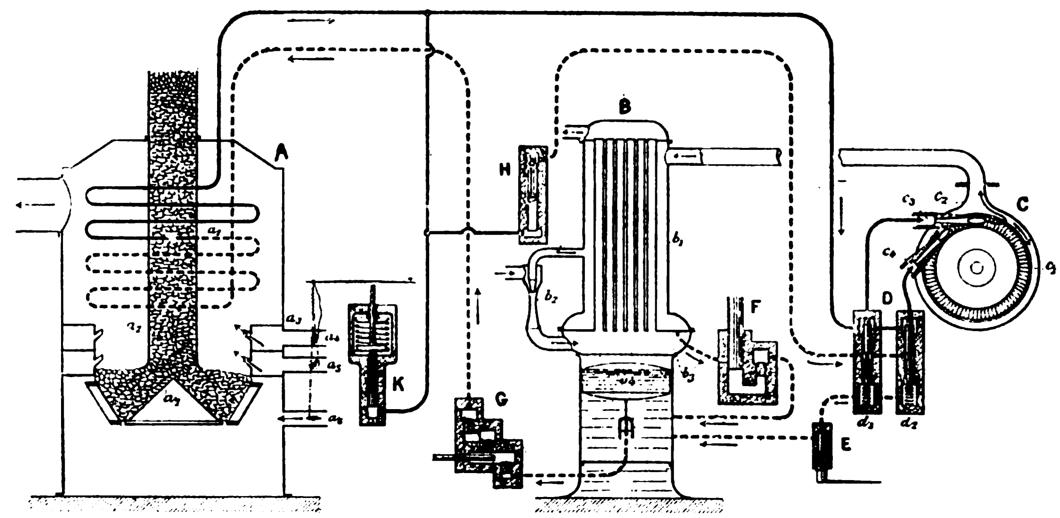


Fig. 2.—De Laval High Pressure Steam Turbine System.

the steam from the generator, has the object of constantly equalizing the pressure of the water which circulates in the regulator D, with the pressure of that steam, and thus it prevents that regulator being always closed to the passage of the steam. The blower connected to one of the auxiliary shafts of the turbine furnishes a quantity of air necessary for combustion, and produces a draft.

The steam regulator K governs the draft. As soon as the valve opens it closes the dampers a_5 and a_6, according to the pressure of the steam and the load on the engine. Finally it can while closing the dampers a_5 and a_6 open the damper a_4, and thus blow the cold air on the coils themselves, thus stopping the generation of steam.

The boiler can evaporate 11 pounds of water per square foot of heating surface, and furnish 7½ to 8 pounds of steam under a pressure of 100 to 220 atmospheres per pound of fuel per hour. Among the principal advantages of this new boiler may be mentioned its simplicity, lightness and small space occupied, ease of erection and installation and of transportation, attendance reduced to a minimum, the ease with which it is kept in operation and the production of dry and superheated steam; and complete safety, the volume of water being very small.

ELECTRIC LIGHT ARCHES AT COLUMBUS, O.

In May, 1896, several wide-awake and enterprising citizens of Columbus organized what is known as The South High Street Business Men's Association for the purpose of promoting trade in the southern portion of the city by introducing attractions for the public, and that would at the same time invite merchants to locate among them.

The Columbus Edison Electric Light Company were requested to suggest some means of lighting five blocks on South High street, between State and Mound streets. It was decided to erect at each street intersection a temporary wooden arch, displaying fifty 16 candle-power lamps each, to be used for three or four nights. This was successfully accomplished by stretching span wires across the street and suspending wooden strips, four inches wide, one inch thick and seventy-two feet in length, and which from their own weight formed an arch and were held in position by vertical guy wires fastened to the span wires.

Universal satisfaction was expressed by both merchants and public at the jubilee opening and negotiation was entered into for the erection of permanent arches, pending which the wooden arches were to remain in place. After the completion of the permanent arches south, the business men and newspapers urged their continuation north to the Union Railway Station, and in February, 1897, a committee from the Business Men's League was appointed to secure data for ten arches north. After several months delay a plan was decided upon by which a committee from each block or section secured sub-

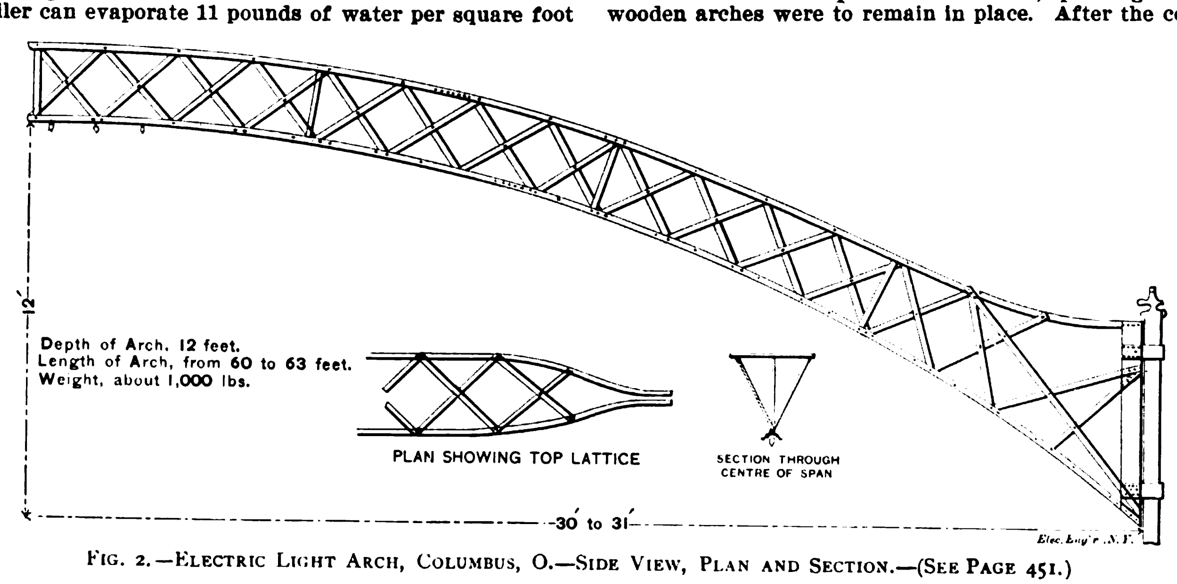


Fig. 2.—Electric Light Arch, Columbus, O.—Side View, Plan and Section.—(See Page 451.)

scriptions for their block and are to act with the company in securing prompt payment of bills.

The plan for the maintenance of the arches south is by contract with an incorporated association, while that north is with the individual, advance payment being required. The average cost is about $2.50 per month on each 30-foot frontage of real estate.

The accompanying engravings show the appearance of the electric light arches, while Fig. 2 shows the details of construction.

There are nineteen of these arches containing fifty 16 candle-power lamps to the arch, placed at street intersections. The arches are made of steel angle iron, connected by lattice work forming a triangular truss. Attached to this is a galvanized iron hood or reflector, with the lamps beneath and extending below the rim of the reflector. Black paint covers the iron work, and white paint is used for the reflector.

Each arch is composed of three sections, riveted together and painted, after which the hood was put in place. Ordinary gas attachments are used and riveted between the angle irons, and projecting down through the top of the hood. Special mica sockets were screwed to the gas attachments and the leads connected to the wires, which were run on the inside of the reflector on porcelain knobs, so that all wiring and connections are completely protected from the weather.

Fig. 1.—Electric Light Arches at Columbus, O.

The arches are erected upon the poles of the street railway through the permission of Mr. W. F. Kelly, General Superintendent Columbus Street Railway Company. They have an average span of sixty-one feet and a depth of twelve feet (see Fig. 2). They are raised twenty feet from the ground at either end of the arch and have thirty-two feet clearance in the center. The ends are fastened to the poles by broad iron bands bolted to the upright brace on the end of the arch. Current is fed direct from the Edison three-wire underground mains, the wires running through ordinary gas pipe. A hard wood lock box containing switch and cut-out connects in the circuit. This box is located about five feet from the ground.

In the erection a guy pole was placed in position midway between the street railway tracks and in line with the poles; the arch being placed on the ground parallel with the trolley wires, is then raised to the proper height above the wires and swung into position. This work was done after midnight in order to avoid street traffic and live trolley wires. The arches were designed by Messrs. Kinkade and Liggett of the Architectural Iron Works, Columbus, O. We are indebted to Mr. A. W. Field, secretary of the Columbus Edison Company, for the data given.

DOES THE COUNTER E. M. F. EXIST IN THE ARC?

BY W. R. BONHAM AND HAROLD ALMERT.

Having followed with interest the many valuable discussions in the recent technical journals regarding the phenomenon of the electric arc, we desire to record an experiment recently performed by us, which we think may throw some light on this interesting subject.

The object of the experiment was to determine whether or not a counter e. m. f. exists in the electric arc.

The method employed was as follows: The total heat energy of the arc was measured and compared with the total energy absorbed by it, on the assumption that if the total heat energy equaled the total absorbed energy of the arc, it would indicate an absence of a counter e. m. f. and a presence of something in the nature of a resistance in its stead; while if the values of the heat energy and the absorbed energy varied greatly, it would favor the assumption that a counter e. m. f. existed.

A constant potential enclosed arc lamp of the Adams-Bagnall type was used to eliminate as far as possible errors due to the heat of combustion of the carbon. As will be seen by the accompanying diagram, the arc lamp was enclosed in a sheet-iron box four feet square. This box was placed in a small inside room of a capacity of about 700 cubic feet, containing no window or transoms and but one door; two pair of leads were brought into the room, one pair being connected to the lamp, while the other pair were connected to a small iron wire resistance R, also placed in the box.

Provision was made for measuring the voltage of either circuit inside of the test room, by means of a Whitney voltmeter and double throw switch, while the current in either circuit was regulated and measured by means of a T.—H. regulator and an ammeter in each circuit, located in an outer room. The current in the arc lamp circuit was measured by an Edison ammeter, while the current flowing through the resistance R was measured by a Whitney ammeter. While neither of these ammeters had been standardized, they were compared

with each other before and after the experiment and found to read the same.

The inside temperature of the box at one point and the temperature of the room at two points were recorded by standard centigrade thermometers.

The arc lamp was permitted to burn for 9.5 hours with 4.65 amperes at 119 volts, when the temperatures of the box and room were found to remain constant at 38.5 degs. C. in the box and 24.75 degs. C. in the room. The heat which maintained this constant temperature was produced in the mechanism, resistance coil and arc of the lamp.

To determine the heat produced by the arc the carbon holders were short circuited, as at A, and the current through the mechanism and resistance of the lamp again adjusted to 4.65 amperes, thus keeping the heat generated in those parts constant. Current was then sent through the resistance R and adjusted until at the end of four hours the same constant tem-

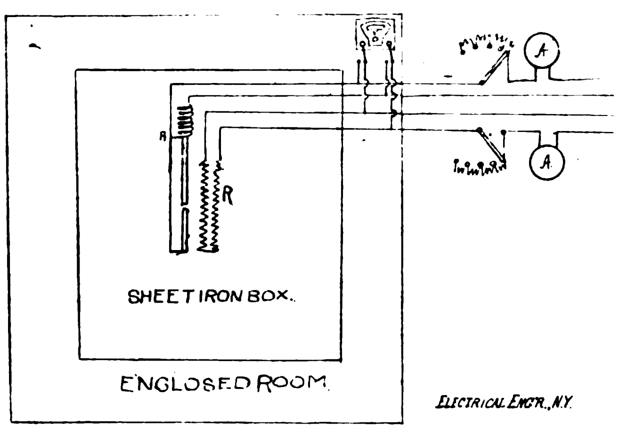


FIG. 1.

peratures of 38.5 degs. C. in the box and 25 degs. C. in the room were obtained.

The energy thus expended in the resistance R, namely, 5.8 amperes at 71 volts, must evidently equal the heat energy of the arc, since the temperatures produced in each case under constant conditions are the same.

The total energy consumed by the arc lamp = 119×4.65, or 553.35 watts. The energy consumed by the mechanism and resistance of lamp = 36×4.65, or 167.4 watts. This subtracted from the total leaves 385.95 watts, representing the energy consumed by the arc. The energy consumed in the resistance R necessary to produce the same heat as that of the arc = 71×5.8, or 411.8 watts, leaving a discrepancy of 25.85 watts, which, under the circumstances, we consider an allowable error.

While we do not pretend to account for the abnormally high resistance present, we think that the experiment proves beyond a doubt that the phenomenon is not due to a counter electromotive force.

AN ELECTRIC MAIL BOX.

A very clever mail delivery box has been placed in a number of the larger buildings at Geneva, Switzerland, by an enterprising electrician. This mail box has a compartment for each of the stories of the building, and when the letters are deposited on the ground floor the carrier delivers them as required. The deposit of a single letter makes an electric contact, which starts a bell going on the respective floor, which does not cease ringing until the letter is taken out. At the same time it opens the faucet of a tank on the roof of the house, which causes water to flow into the cylinder forming the counterweight of the mail box elevator until the weight is heavier than the box, when the box ascends and the flow of water ceases simultaneously. As the box passes each story the mail intended for it—letters, papers and small packages—falls into boxes in the corridor on that floor. This is performed very reliably by a little spring at the bottom of each compartment in the elevator mail box, which causes the bottom of the compartment to catch for a moment, and the release throws out even a single piece of paper thinner than a postal card into the stationary box provided for its reception. When the box has passed the uppermost floor the cylinder filled with water strikes a bolt provided at the bottom, which allows the water to flow out, and by its own weight the box descends to its place on the ground floor. Should by any mischance a single piece of paper have remained in the elevator, upon striking the bottom it will at once go through the same series of movements as before.

TESLA'S HIGH POTENTIAL TRANSFORMER.

In his experiments involving high potentials Mr. Nikola Tesla has for some time past made use of a special form of induction coil, and in a recent patent issued to him he describes several forms specially adapted to be used in connection with a system of high potential power transmission. To accomplish the desired object Mr. Tesla employs an induction coil or transformer in which the primary and secondary coils are wound in such manner that the convolutions of the conductor of the latter will be farther removed from the primary as the liability of injury from the effects of potential increases, the terminal or point of highest potential being the most remote, and so that between adjacent convolutions there shall be the least possible difference of potential.

The type of coil in which the last named features are present is the flat spiral, and this form Mr. Tesla generally employs, winding the primary on the outside of the secondary and taking off the current from the latter at the center or inner end of the spiral.

In constructing his improved transformers Mr. Tesla employs a length of secondary which is approximately one-quarter of the wave length of the electrical disturbance in the circuit including the secondary coil, based on the velocity of propagation of electrical disturbances through such circuit, or, in general, of such length that the potential at the terminal of the secondary which is the more remote from the primary shall be at its maximum. In using these coils the inventor connects one end of the secondary, or that in proximity to the primary, to earth, and in order to more effectually provide against injury to persons or to the apparatus he also connects it with the primary.

The accompanying diagram, Fig. 1, illustrates the plan of winding and connection employed in constructing the improved coils and the manner of using them for the transmission of energy over long distances.

A designates a core, which may be magnetic, around which the coil B is wound in spiral form. C is the primary, which is wound around in proximity to the secondary. One terminal of the latter will be at the center of the spiral coil, and from this the current is taken to line. The other terminal of the secondary is connected to earth and also to the primary.

When two coils are used in a transmission system in which the currents are raised to a high potential and then reconverted to a lower potential, the receiving transformer will be

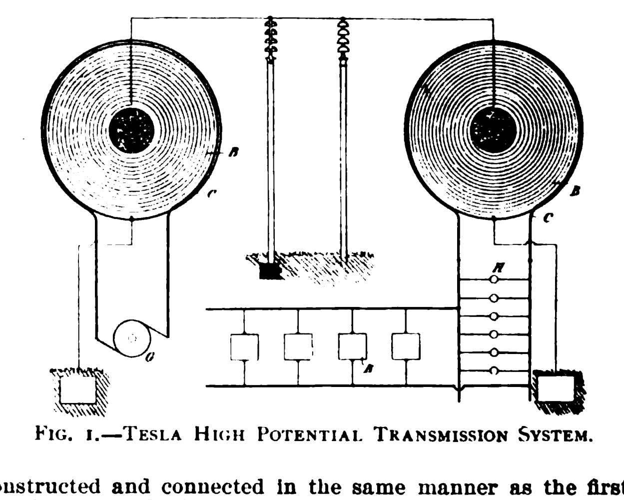


FIG. 1.—TESLA HIGH POTENTIAL TRANSMISSION SYSTEM.

constructed and connected in the same manner as the first—that is to say, the inner or center end of what corresponds to the secondary of the first will be connected to line and the other end to earth and to the local circuit or that which corresponds to the primary of the first. In such case also the line wire should be supported in such manner as to avoid loss by the current jumping from line to objects in its vicinity and in contact with earth—as, for example, by means of long insulators, mounted, preferably, on metal poles, so that in case of leakage from the line it will pass harmlessly to earth. In Fig. 1, where such a system is illustrated, a dynamo G is rep-

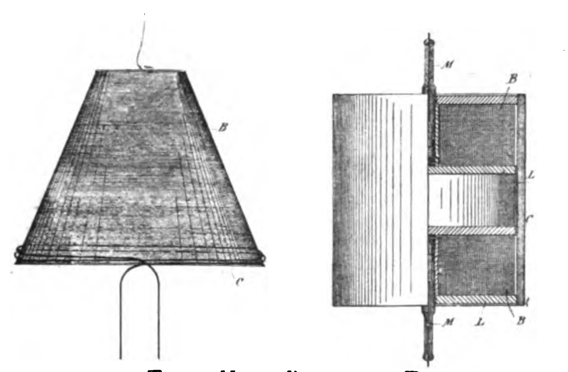
resented as supplying the primary of the sending or "step-up" transformer and lamps H and motors K are shown as connected with the corresponding circuit of the receiving or "step-down" transformer.

Instead of winding the coils in the form of a flat spiral the secondary may be wound on a support in the shape of a frustum of a cone and the primary wound around its base, as shown in Fig. 2.

In practice for apparatus designed for ordinary usage the coil is usually constructed on the plan illustrated in Fig. 3. In this figure L L are spools of insulating material upon which the secondary is wound—in the present case, however, in two sections, so as to constitute really two secondaries. The primary C is a spirally-wound flat strip surrounding both secondaries B. The inner terminals of the secondaries are led out through tubes of insulating material M, while the other or outside terminals are connected with the primary.

The length of the secondary coil B or of each secondary coil when two are used, as in Fig. 3, is, as before stated, approximately one-quarter of the wave length of the electrical disturbance in the secondary circuit, based on the velocity of propagation of the electrical disturbance through the coil itself and the circuit with which it is designed to be used—that is to say, if the rate at which a current traverses the circuit, including the coil, be 185,000 miles per second, then a frequency of 925 per second would maintain 925 stationary waves in a circuit 185,000 miles long, and each wave length would be 200 miles in length. For such a frequency Mr. Tesla would use a secondary 50 miles in length, so that at one terminal the potential would be zero and at the other maximum.

Coils of this character, according to Mr. Tesla, have several



FIGS. 2 AND 3.—TESLA HIGH POTENTIAL TRANSFORMERS.

important advantages. As the potential increases with the number of turns the difference of potential between adjacent turns is comparatively small, and hence a very high potential, impracticable with ordinary coils, may be successfully maintained. As the secondary is electrically connected with the primary the latter will be at substantially the same potential as the adjacent portions of the secondary, so that there will be no tendency for sparks to jump from one to the other and destroy the insulation. Moreover, as both primary and secondary are grounded and the line-terminal of the coil carried and protected to a point remote from the apparatus the danger of a discharge through the body of a person handling or approaching the apparatus is reduced to a minimum.

TESTING THREE-PHASE INDUCTION MOTORS—TRANSFORMER CONNECTIONS—FULL LOAD CURRENTS—FAULTS AND HOW LOCATED.—I.

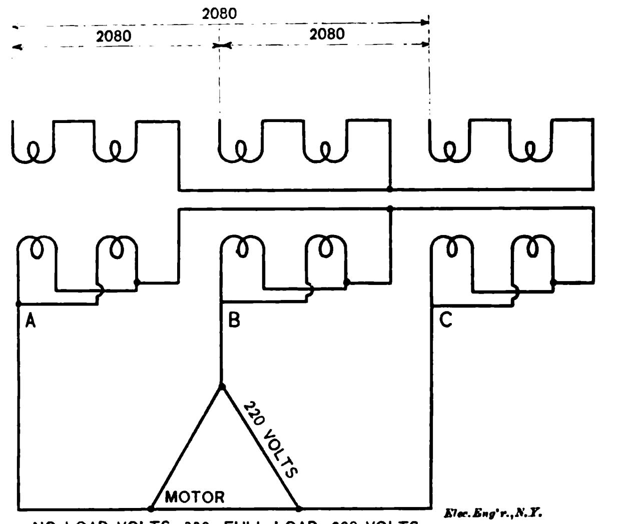
BY W. T. MORRISON.

An induction motor is very simple in operation, having no commutator, brushes or other parts to adjust while running. There seems to be nothing to get out of order. When, however, a machine fails to operate rightly the locating of the fault is not so easy, especially to those not experienced with this class of motors.

Fig. 1 represents the three-phase connections for installing a 220-volt motor with three transformers. If the transformers are large enough the motor could be run on two if one transformer should break down. While in theory the two-transformer method, having more induction between the two outside legs than between the middle and either outside line, is not so good, yet for commercial purposes it is perfectly satisfactory.

When installing motors the horse power of the motor should equal the total k. w. capacity of the transformers, whether two or three transformers are used. Small motors should have a k. w. capacity in transformers slightly in excess of the horse power of the motor. Thus a 50 h. p. motor should have 50 k. w. in transformers. A 3 h. p. motor should have about 3½ k. w. in transformers.

In insulating motors on alternating circuits of 2,080 volts ratios of 9 to 1 and 18 to 1 should be used for motors of 220 and 110 volts, respectively. Ratios of 10 to 1 and 20 to 1 will



NO LOAD VOLTS, 232: FULL LOAD, 220 VOLTS.

FIG. 1.—TRANSFORMER CONNECTIONS FOR THREE-PHASE MOTOR.

not answer, as the voltage on the motors at full load would be low.

In Fig. 1 a ratio of 9 to 1 is obtained by connecting the primaries in series Y and the secondaries in multiple Y. The ratio of one coil of the primary to one of the secondary being 4.5 to 1. The volts per line on the primaries of transformers connected in Y are, of course, equal to $\frac{\text{line volts}}{\text{No. coils} \times 1.73}$ or the line voltage divided by 3.46, for two-coil transformers.

Before starting the motor the volts should be tested across the motor mains to see that they are equal. If the three voltages between A, B and C are equal the motor should run all right. On the other hand, if they are unbalanced to any extent the transformer connections should be looked up.

The following facts as to currents, etc., will be found convenient in testing as a general guide and check on results. These items and the testing points in this article apply especially to three-phase motors of the General Electric Company design. Full load current for small motors from 1 to 4 h. p. should be about 6 amperes per h. p. per leg per 110 volts.

When any other voltage is used the calculation is apparent at once. Thus, full load for a 220-volt machine would be ½×6 amperes per horse power per leg and for a 550-volt machine 1-5×6, similarly expressed. Motors of medium size, say 4 to

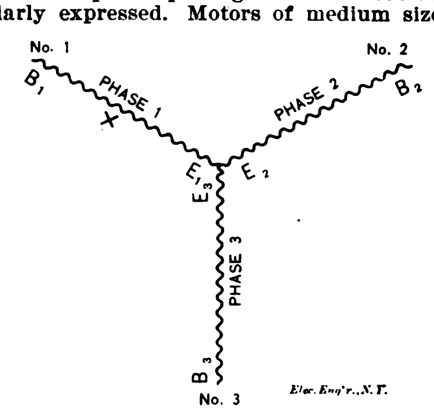


FIG. 2.

50 h. p., take about 5.6 amperes per leg per 110 volts; large motors of 75 h. p. and upward take about 5.2 amperes. The current running light is usually 25 to 30 per cent. of full load. The current at maximum output is about 200 per cent. of full load. The static current at full voltage with no resistance in the armature is about 300 per cent. of full load. When all resistance is in the armature circuit, as when the motor is starting, the current is 150 per cent. of full load. The starting torque is usually 150 per cent. of full load running torque.

The maximum output of a motor is usually 150 per cent. of the rated power. This sometimes, however, runs as high as 200 per cent. The above facts relate only to standard motors, not to special elevator or hoist motors, or motors designed for other special purposes, as coal cutter motors, etc. With a few such points in mind one can judge pretty well of the character of a motor after making the usual tests, which include these points.

If the motor fails to come up to speed, tests should be made for a reversed phase. Placing the hand on the motor to see if there is any vibration, other than the usual mechanical jarring, is a good test. If there is any radical defect in the field it can almost always be detected by a vibration, accompanied by a humming sound. In order to distinguish this from the ordinary noise of the machine, place the ear close to the frame, while running free, and have the current thrown on and off a number of times. If the vibration and noise ceases the instant the current is broken, and is apparent again as soon as connection is made with the circuit, a defective field may be safely assumed. This defect, causing noise and electrical vibration, may be due either to a short circuit turn, or coil, or to a reversed coil or phase, but in the first three cases the speed will not probably be affected.

To distinguish between a reversed coil and a reversed phase the following points should also be noted. The unbalancing of current and voltage in legs A, B and C, will be greater with a reversed phase than if it is merely a coil. The motor, moreover, will fail to carry its load. Having cut off the current and started the motor rotating in the opposite direction if the current is now thrown on and the motor continues to rotate in this direction, it runs as a single phase motor and shows that a phase has been reversed. It will not always act this way, however.

To Locate a Reversed Phase.—First method, by single phase testing.

The diagram, Fig. 2, represents a Y connected motor. The cross on a phase in this diagram represents a reversal of the phase or of a coil in that phase. By the cross on phase 1, Fig. 2, it is evident that this phase is reversed, that is, B_1 put in the place of E_1. If impedances are taken on legs 1-3 and 1-2 and 2-3 the first two legs will be high, while the last one taken will be normal, as this one includes phases 2 and 3, which are all right. Therefore, the defective phase is the one not included in the low leg.

MISCELLANEOUS

HELM ANGLE INDICATOR.

IN our last issue we described the ingenious revolution indicator built by the Electro Dynamic Co., of Philadelphia, and introduced on a number of the United States warships

FIG. 2. ELECTRO DYNAMIC CO.'S HELM INDICATOR.

and the merchant marine. The same company has also brought out a complement to the revolution indicator in the shape of a helm angle indicator, the object of which is to show the helmsman graphically the position of the rudder.

The helm angle indicator consists of two parts, the transmitter and the indicator or indicators. The transmitter shown diagrammatically in Fig. 1 has a lever traveling over an arc and attached to the rudder post, and making contact with the segments corresponding to the angular arc, and the indication of the instrument is so designed that the lesser angles, which are more commonly used, give a larger indication than the greater angles, which are more rarely used. From the transmitter two small wires are run to the steering stations and such other locations as are desirable.

The indicators, one of which is illustrated in Fig. 2, are enclosed in an iron waterproof case suitable for deck or bulk-

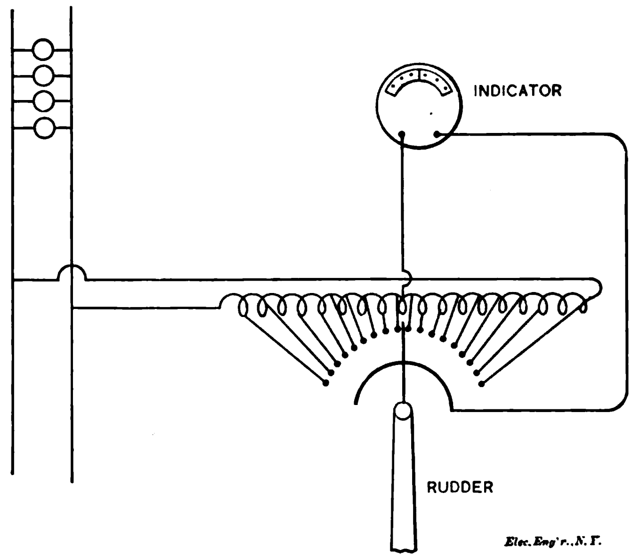


FIG. 1.—DIAGRAM SHOWING OPERATION OF HELM INDICATOR.

head use, having a glass dial covering a 7½-inch scale, which is divided into forty divisions each side of zero. When the ship has an electric lighting plant facilities are provided to light the scale with a small electric lamp at night. Two switches can be placed in a convenient location for closing the circuits of instrument and lamp.

Current is furnished by a battery of closed circuit cells which require no attention other than renewal about once yearly at a slight cost. Current can also be taken from the electric lighting plant of the ship.

If desirable the indicators not in use may be disconnected without affecting the value of the indication of the other instruments. The indicators in no way affect the compass.

As an instance of the benefits of the helm angle indicator it may be mentioned that it has been found that on one of the record-breaking trans-Atlantic liners, that by adjusting the speed of engines so that the helm could be maintained amidships, the lessening of friction resulted in a saving of two hours' time on a trip across.

DEVICES FOR SUPPORTING LARGE CONDUCTORS.—I.

BY S. H. SHARPSTEEN.

THERE is nothing that seems simpler to some young wiremen than to string wire on a ceiling or do what is called open work. It looks like a job that might be accomplished with ease, but when once tried a person is apt to change his mind. A good wireman will put a No. 4 or 6 wire on a ceiling so that it will stay tight and straight for years, while some wiremen could not get a No. 4 wire up tight and without crooks if their lives depended on it.

It is quite a common thing in these days to be compelled to put up wire of large size in buildings and subways, the conductor being sometimes an inch in diameter, composed of small strands. This is the best wire with which to make a good job, since it is so strong it will remain so. It could be used to hang a man upon if necessary without sagging. Regardless of this fact, we see it hanging in festoons about electrical plants. Wiremen start out with good intentions; they get timber, bolts and large pieces of porcelain, with many men to pull, and tackle blocks to multiply the pull, but when the wire is up and fast and the men are gone it seems to hang in festoons just the same.

The prime reason for so many failures in this kind of work is the fact that people who undertake to string such wire do not comprehend what they are trying to do. This is proved by the fact that we see large wire that shows signs of being pulled up very hard, so hard, indeed, that the insulation has

been pulled off and still the wire is slack, simply because it was not held in place.

Let us consider a plan for wiring from the back of a switchboard in a railroad power house, to the point where the wires leave the building. Assuming that there are to be four circuits, the conductors of which are one inch in diameter, the insulation one-fourth of an inch thick. This would give us a finished wire 1½ inches in diameter. At A, Fig. 1, we will have a piece of slate 3 inches thick, 10 inches wide and 62 inches long. This slate we will bolt firmly to four pieces of oak, bolted to the wall, and mortised so that the slate will set into them, the oak coming flush with the front of the slate. The oak should be wide enough so that the bolts that are to hold the wire can be pushed through from the back. It might be concluded to place the bolts before putting the slate in position, but if space enough is not left for the removal of bolts after the work is finished, something might happen that some one of the bolts might need to be taken out; in such an emergency it would be necessary to unfasten the slate from both wires and oak strips, if the space was too small between slate and wall.

The strain on the slate will be heavy, hence it should be well fitted into the oak pieces before being fastened. It is also very essential that all the oak pieces be well fastened to the wall so as not to move when some one wire is pulled up, and break the slate. The better plan would be to have the oak pieces put in when the wall is being laid up, if the building is of brick.

Brass terminals should be made large enough to extend about four inches over the whole number of strands in the conductor; one end should be flat and about three-fourths of an inch in thickness, with an eye large enough to take an inch and a quarter bolt. The insulation should be cut squarely off the wire so as to set snugly up against the end of the terminal.

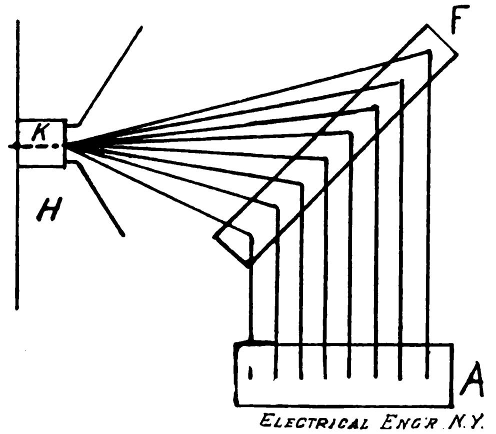


FIG. 1.—METHOD OF FASTENING HEAVY CONDUCTORS.

It is necessary to feather out the end of the conductor and clean each wire so that it will take the solder. When ready to sweat in, it should be well treated with soldering solution pushed into the terminal and by means of a good torch and a hole in the side of the terminal, well filled with solder. It seems like a large bolt to hold the end of the wire, but it must be remembered that the slate is quite brittle and the large bolt is necessary to get the proper bearing surface to stand the pull of the cable. The slate should stand the pull better if the holes are made somewhat nearer the bottom.

At F or the place that we make our turn to go to the left we will place two oak panels six inches wide and two inches thick between which we will fasten with inch bolts porcelain insulators over which the wires are to pass; the oak planks should be firmly framed together at each end and each bolt that holds the knobs should pass through the wall of the building and hold the work solidly fast.

The porcelain should be six inches in diameter, at least four inches through the hole, and the groove should fit around the wire for at least one-half of its diameter. If the porcelain is not made to fit the insulation on the wire, the wire will flatten badly when pulled up. If the conductor is more than an inch in diameter it might be good practice to put two porcelain insulators at the angle instead of one, and make the bend more gradual. In this case two frames for holding wires would have to be put up instead of one.

The bolt for pulling up could be very easily provided for if the fire underwriters would allow the use of fibre. A heavy oak timber could be well fastened up, a hole bored through, a fibre tube put around the bolt, a fibre washer under the bolt head and the arrangement would be complete. Fibre and wood are not allowed in this case, hence we must look to something that is allowed.

In the brick wall of the station H, there should be placed a piece of slate K, six inches square and long enough to suit; through this slate have holes 1⅝-inch in diameter and about 18 inches apart. A terminal about 24 inches long by 1½ inches in diameter, with a thread cut on one end for 15 inches, and a hole bored in the other end for about 4 inches, will have to be prepared for each wire passing out of the building.

Engineers who have had experience with this kind of work will see at a glance some of the conveniences of this arrangement. The wires can be fastened on the slate board A, passed over the insulator at F, and by means of a tackle block pulled up tightly and near K cut off, the brass bolt sweated on, passed through the proper hole, and with a nut and washer pulled up tightly and held. The work can be made so firm that a man can walk across the wires where they are arranged for passing out of the building, and they will hardly show any perceptible sag under him, acting more like rigid rods of iron than like loose wires.

When properly pulled up the outside end can be cut off if it be too long and onto this bolt can be fastened the street circuit, by means of the proper terminal on the street wire and an extra nut. This dispenses with the poor work and broken tubes that are so often seen about these places.

It is understood that the side of the wall where the wires merge should be protected by a roof of some kind so as not to be directly exposed to the weather, although this would not be absolutely essential with only five or six hundred volts pressure. Almost all pole lines are changed at one time or another and at such a time it would, with this arrangement, be an easy matter to get the wires loose for changing them.

METERS FOR ELECTRO-THERAPEUTIC WORK.[1]

IN making its report the committee expressed a feeling of gratification at finding a disposition on the part of manufacturers of meters to do their utmost to accommodate the committee and to adopt their instruments to the need of the profession. It is also a matter of interest that several makes of meters have been withdrawn permanently from the tests of the committee because of their demonstrated inefficiency.

In this year's test, as in all previous tests of meters made by the committee, the Weston meter was selected as a standard. As its selection has been criticised in some quarters the committee, in its report, justified itself for making the selection, and quoted a letter from Professor F. B. Crocker of the Columbia School of Mines, in which he says: "In regard to the Weston instruments, I can say that I have the highest opinion of their accuracy; in fact, I think it is hardly necessary to verify them. If I had two of them, and their indications agreed, I should feel practically sure that they were correct. As a formality or extra precaution it might be desirable to standardize them, but I do not think there is any real necessity for it."

On several occasions in the past the committee has called attention to the undesirability of making a meter for direct current reading higher than 100 milliamperes. Enlarged experience in clinical and office work shows that the occasions for the use of larger applications than 100 milliamperes are extremely rare, so rare, in fact, as not to compensate for the general loss in efficiency of operation of a meter having higher readings.

The formal test on the meters was made at the office of Dr. Margaret A. Cleaves on September 14, 1897. Dr. Cleaves and Mr. E. W. Hammer of the committee were present, as were also the following gentlemen: Mr. Beneoky, of the Weston Company; Mr. Hedgmann, of the Edison Manufacturing Company; Mr. Wappler, of the J. C. Vetter Company; Mr. Livingstone, of the Jerome Kidder Company; Mr. Jewell, of the McIntosh Company, and Mr. Stevens, of the Keystone Company; there was no representative of the Chloride of Silver Dry Cell Battery Company present. The eight meters in the test were placed in series with each other and current was passed through them from the Edison street circuit, the variations in current being obtained by manipulation of appropriate resistances. The report was accompanied by a table showing the results of the test.

The Committee on Meters has been striving for several years to arouse the meter manufacturers to the consideration and development of milliampere meters and voltmeters for use on alternating current circuits, both the sinusoidal and the interrupted or Faradic. In the last report some reference was made to instruments used for this purpose abroad, and it is gratifying to find that the Keystone Electrical Instrument Company, of Philadelphia, has perfected apparatus for these currents. It will now be possible for the physician to make

[1]Read before the Am. Electro-Therapeutic Association.

observations in terms of volts and milliamperes instead of the indefinite method heretofore employed. A statement of the latter has usually been about as follows: "Induced current, primary or secondary, slow or fast interruption (as the case may be), 1,800, 1,500. 1,200 or less yards or number of turns, regulated through the rheostat to the patient's toleration."

The Keystone meters are based on the dynamometer principle. The readings are in virtual or effective milliamperes or volts. The indications of the meter, if the system is properly constructed and with a proper ratio of turns in the fixed and moving coils, is entirely independent of the frequency of the currents and approximately independent of the wave form.

In closing its report the committee stated that while recognizing the importance of the tests which have been made of meters from year to year, it believes that it would be to the interest of all the manufacturers who have heretofore submitted their meters for temporary trial, to now send samples of their instruments to the committee that observations may be made upon the same during the entire year.

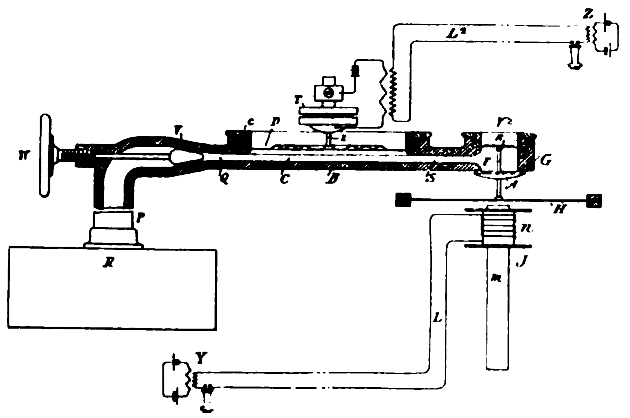
The members of the committee are Dr. Margaret A. Cleaves, chairman, New York City; Edwin W. Hammer, E. E., Newark, N. J.; and Dr. Caleb Brown, of Sac City, Iowa.

TELEPHONY AND TELEGRAPHY

THE ERDMAN TELEPHONE RELAY.

THE telephone already reaches out to distances deemed impossible, or rather impracticable, ten years ago, as witness the recent connection of Omaha with New York, a distance of 1,500 miles. All the work of the Long Distance Company, however, is still done by direct transmission from one end of the line to the other without any intermediary or re-enforcing station, but the quest for a telephonic relay has by no means been abandoned, and this for several reasons. First of all, a good telephone relay would increase the margin of loss in articulation permissible in the line; and, second, it would permit of a marked decrease in the cost of long distance telephone lines.

These considerations have led a number of inventors to try their hands at the problem, but thus far no such apparatus has come into practical use. The most recent attempt is embodied in the highly interesting apparatus designed by Mr. Albert W. Erdman, of Milburn, N. J.



THE ERDMAN TELEPHONE RELAY.

The action of the Erdman relay may be resolved into three steps, namely: First, transforming the electrical undulations or vibrations of the incoming telephonic current into corresponding mechanical vibrations; second, amplifying these mechanical vibrations by applying them to a device which varies the flow, and therefore the pressure, of a current of air flowing through a chamber covered by a flexible diaphragm, the amplifications appearing in the motion of the flexible diaphragm as it responds to the varying pressure within the chamber; third, transforming the amplified vibrations of the diaphragm into electrical undulations or vibrations in the outgoing or relayed telephonic current, which, like those of the first circuit, represent the sonorous vibrations of the originally uttered and transmitted sounds, but which flow in the second circuit and operate the distant telephone receiver.

Fig. 1 is a view, mainly in section, of a relaying or repeating apparatus embodying these principles. Here R is a reservoir of compressed air maintaining a constant pressure supply at the reducing valve V. This valve is placed in the supply pipe at a point between the reservoir R and an air chamber C and is adjustable by the hand wheel W. The air chamber C is formed with a circular basin B. which has its upper side closed or covered by the flexible diaphragm D. The vibratory diaphragm D thus forms a flexible or movable wall of the air chamber and carries a carbon telephone transmitter T, of the usual type.

The air chamber C communicates through the passage Q and the reducing valve with the supply pipe P, and by means of the passage with the interior of the body G of a balanced valve V^2, which valve contains the flexible diaphragm E, the movable part of the valve A, and its actuating rod F.

J is a telephone receiving instrument constituting the receiving element of the relay apparatus, and H being its diaphragm. The actuating rod F of the balanced valve is fixed centrally to the moving part of valve gate A and is secured at one end to the flexible valve diaphragm and at the other to the flexible diaphragm H of the receiver J, so that any vibrations set up in the latter can be imparted to the moving part of the valve.

L is the first or transmitting main telephone circuit leading into the repeating station from a distant telephone station Y, where it is provided with the usual transmitter and receiver and connected at the repeating station with the receiver J. L^2 is the second or receiving main telephone circuit or line leading from the repeating station, where it is associated with the transmitting element, comprising the diaphragm D and T of the relay apparatus, to a distant telephone station Z, likewise fitted with telephones similar to those at station Y.

The operation of the relay apparatus will now be readily understood. The electrical undulations of the incoming telephone current are in the receiving portion of the apparatus transformed into the mechanical vibrations or motions of the diaphragm H. The vibrations of this diaphragm are imparted to the valve gate A of the balanced valve V^2 through the rod F. The motion of this valve gate is, however, unaffected by the internal pressure of the current of air within the valve casing, because the pressure upon the internal surface of the gate is balanced by the pressure upon the internal surface of the flexible diaphragm E. This feature of operation enables the valve gate to be set in motion by a feeble force unaffected by the air pressure within the valve casing G for a considerable range of pressure variation. The mechanical vibrations of the diaphragm H are imparted to the diaphragm D through the intermediary of the pressure vibrations of the air current, within the chamber of which the latter forms a flexible or vibratory wall, and in process of such transfer are amplified or built up and then retransmitted to the line L_2.

NORTH ATLANTIC CABLES.

There seems to be good reason for believing that the long discussed North Atlantic cable will soon be an accomplished fact. The Icelandic Parliament has accepted the offer of the Great Northern Telegraph Company in Copenhagen to lay a cable to Iceland from the North of Scotland by way of the Faroe Isles and has granted it the required subsidy of 30,000 kroner annually for twenty years. The Danish government also has promised financial help. It is expected that the cable will be laid next summer. The distance from the nearest point of Scotland to Thorshavn, in the Faroes, is about 250 miles, the greatest depth 254 fathoms, while the bottom is composed of debris of shells and mud. From Thorshavn the cable goes first either to Haldevig or Westmanshavn. The distance from the Faroes to Iceland is—according to the landing place selected—to Ingolfshöldi 280 miles, to Portland 350 miles, to Bernfjord 240 miles. The last-named is the best landing place. The depth in this part averages a little under 300 fathoms. If the cable is landed at Bernfjord it will be continued overland to Reykjavik. It must be laid north of the glacier plateau of Vatna Jökul. The following routes may be chosen: (1) via the Sprengisand, a distance of 250 miles; (2) close to the north of Vatna Jökul, 210 miles; (3) across North Iceland, 310 miles. Lastly, the cable may be laid on sea bottom round the south coast of Iceland and round Cape Reykjanoes, a distance of 260 miles. That the cable will be extended before long to British North America is regarded as a matter of certainty.

ELECTION NEWS BY TELEPHONE.

During the recent election in Greater New York the New York Telephone Company made arrangements to distribute the election news by telephone. A number of telephones were placed at Police Headquarters and the returns from the various points of Greater New York were transmitted by the police authorities to headquarters; there as rapidly as tabulated the returns were transmitted by telephone to the offices of the Telephone Company ,and thence distributed to various hotels and clubs.

In addition to this service arrangements were made under which any telephone subscriber was able to obtain the news at any time after 5 p. m. on election day by calling Central and asking for election news. The Central Office operator connected the subscriber direct with an information bureau situated in the Telephone building, on Thirty-eighth street. Here a large staff of men were employed in answering inquiries of this character. All that was necessary was to call the Central office and in response to the usual telephone inquiry "what number?" reply "election news." The service was remarkably prompt and accurate.

TELEGRAPH TO THE KLONDIKE.

Charles R. Hosmer, general manager of the Pacific Postal Telegraph Company, says regarding telegraph communication with Klondike that he understood the Dominion government had the matter under consideration. No insurmountable difficulties are in the way, either in the construction or the maintenance of a telegraph line via Ashcrost and Quesnelle, which was the route adopted in 1866 for connecting Asia and America via the Behring Sea. The route passes through the present Klondike country. A line connecting Quesnelle, the northernmost point in British Columbia reached by telegraph, and Dawson City, if decided upon within a few months, could be in operation before this time next year. Stations can be established every four miles and they would be used in connection with the mounted police and other departments.

TELEGRAPH AND TELEPHONE POINTS.

The right of a telephone company to require a telegraph company to place a telephone instrument in its office for use in receiving and transmitting messages on the ground that it has allowed another telephone company to have an instrument there for that purpose is denied, in People ex rel. Cairo Telegraph Company vs. Western Union Telegraph Company (Ill.) 36 L. R. A. 637, on the ground that the telegraph company cannot be compelled to receive oral messages and that by waiving its rights in that respect in favor of one company it is not compelled to do so in favor of another.

A contract limitation of sixty days within which a claim must be presented for damages or statutory penalties on account of the default of a telegraph company in respect of the transmission of a message is held, in Western Union Telegraph Company vs. Eubank (Ky.) 36 L. R. A. 711, to be unreasonable and contrary to public policy as well as in violation of the State constitution.

SHE WOULDN'T DO.

The telephone bell in the office of Blank, Dash & Co. jingled noisily. The young woman who attends to the typewriting responded.

"Is this Blank, Dash & Co.?" came a faraway voice.

"Yes."

"I want Blank, Dash & Co."

"This is Blank, Dash & Co."

"Who is this talking?"

"It's Blank, Dash & Co."

"Is this Blank?"

"No; it's Blank, Dash & Co."

"Say, this is a lady talking, isn't it?"

"I tell you it is"——

"It's a lady, isn't it?"

The young woman hesitated. She was annoyed by the caller's persistency.

"Yes," she said, "it's a lady, but"——

"Well," said the caller, "will you please have a man step to the 'phone?"

"A man?" repeated the typewriter.

"Yes. I want somebody I can damn."

The young woman set the receiver down very suddenly and called Mr. Dash to take her place.—Cleveland Plain Dealer.

THE TELEPHONE is being much resorted to as a means of quick, direct communication in the yellow fever districts down South.

LETTERS TO THE EDITOR

SOME REASONS FOR FLAT RATES.

I HAVE read with considerable interest the article on Meters versus Flat Rates. No one, for an instant, questions the advisability of using meters whenever the customer will contract for same, but in the majority of towns the electric light company has to contend with Welsbach burners as well as cheap gas. The first question asked by a prospective customer is, "How much is it going to cost; will it cost more than gas? If so, I don't want it." In order to get a customer to install electric lights the central station has to offer inducements. When a prospective customer knows the certain cost each month, you can generally land him.

The writer's experience has covered ten years in handling stations all over this country, from the largest to the smallest, and a time limit for burning, with a price for a certain time has been found to be very successful. Excessive lamp renewals in small stations are due not so much to the longer hours as to excessive range in the voltage carried. In one station there has been a variation from full load at 7:30 p. m. 108 volts to 122 volts at 12:30 a. m. at the centre of distribution, due to the fact of the load decreasing, although the voltage was carried steadily at 108 volts at the station. I submit a few figures to show the cost of operating a central station with 70 1,200 c. p. arcs; 1,500 16 c. p. incandescent, using 7,500 watt transformers and only a few meters, most lights being on contract and a time limit for burning, the station running from 4 p. m. to 7 a. m.

Cost coal per k. w.	.87
" oil, waste and packing	.87
" carbons	.09
" arc globes	.005
" office expense	.03
" lamp renewals	.10
" water	.05
" general expenses	.01
" station expenses	.008
" insurance	.106
" taxes	.12
" wages	1.05
" repairs building	.04
" " steam plant	.14
" " electric plant	.06
" " street lines	.03
Total cost per k. w.	2.73
Income per k. w.	4.26
	1.53

This station is an old station with high speed engines A. and S. and Ball and return tubular boilers ten years old, S. P. 80, and is to-day operating at 65 per cent. of its gross revenue.

The writer does not want to give the impression that he advocates a contract system, but gives these figures to show what can be done by operating a station economically with a contract system with a time limit for burning.

STATION MANAGER.

November 3, 1897.

ELECTRIC MOTORS FOR SMALL BOATS.

According to a dispatch from New Haven, Conn., Hon. F. B. Torrey, of Bath, Me., proposes to establish in New Haven or Bridgeport a plant for the manufacture of electric motors and propellers for small boats. The portable electric motor, rudder and propeller weighs about 25 pounds, and is quickly attached to any rowboat or tender, and is hooked in the gudgeons in the same way a rudder would be placed in position. The motor being small, is mounted on top of the rudder, and operated by a primary battery, placed either in the bow or under one of the seats. The propeller is attached to the rudder with a shaft connecting it with the motor, the tiller arm extending around under the arm of the party steering. The power is controlled by a small rotary cock handle at the end of the tiller arm, which is always held in the hand of the man in charge. An electric switch is attached inside the handle, which controls the current either for forward or backward running. The battery will run a boat all day and it takes only a few moments to pour in a new solution.

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INSULATED WIRE CONSOLIDATION.

AS already noted in The Electrical Engineer, there has for some time past been a movement among the manufacturers of insulated wires and cables in this country for a general consolidation of their interests. At the present moment, the matter is one of universal gossip in the trade. Originally, a plan of pooling was proposed, but now, it is said, some 15 or 16 makers are likely to get together in one organization, closing up all but five or six of the best factories, but retaining all the popular brands and trademarks. The manufacturers are themselves unwilling to talk freely on the subject, but it is believed that the deal is now well advanced, including other arrangements by which, for certain concessions, the new company will agree to buy its chief raw materials from certain parties. It is said that the deal will not, if carried through, involve much actual handling of cash. The total amount of insulated wire and cable made in this country can only be conjectured by outsiders. Probably $10,000,000 per year is a safe figure. Owing to the late cutting in prices, most of that has of late been sold with little profit.

WILL ALUMINUM DISPLACE BRASS?

EVER since aluminum became a factor among the constructive materials of the mechanic arts, speculation has been rife as to the ultimate position which it will occupy relative to other metals heretofore in common use. At first its comparatively high cost placed it beyond the pale of direct competition, confining and relegating it to uses where its lightness and other characteristic properties made its employment advantageous. But with every succeeding reduction in the price of aluminum its field of utilization has been widened, and now, indeed, we are actually confronted with the claims of the manufacturers that aluminum is cheaper than brass. The latest price list issued by the Pittsburg Reduction Company would seem to bear out this claim, and in view of the important position of brass in the electric arts it is well worth while to follow up the matter and determine the scope of the recent change of conditions. Comparing the cost of the two metals, we note that the base price of the price list of ordinary brass sheet is 22 cents per pound, and the maximum discount to ordinary customers is 45 per cent., making the net price for brass sheet 12.10 cents per pound. It is a fact that there is a further discount in special cases of 5 per cent., and also ½ per cent. for cash in ten days. This would mean at the lowest rate 5 per cent. off from the 12.10 cents, or 11.495 cents per pound; and where a cash discount is availed of further, ½ per cent., or a rate of 11.338 cents per pound.

Now, the Pittsburg Reduction Company publishes discounts of 10 per cent. and 5 per cent. for large quantities of strip-rolled aluminum sheets; that is, 10 per cent. from the 38 cents per pound, would give 34.2 cents per pound, and 5 per cent. further would give 32.49 cents per pound. From this it is evident that the aluminum price would be 32.49 cents per pound in the lowest rates in ordinary large transactions, as compared with 11.338 cents per pound for the price of brass sheet.

The specific gravity of cast brass is 8.32 and of wrought brass 8.549; but cast brass is 3.25 times heavier than aluminum and wrought brass 3.19 times. Hence, by multiplying the lowest selling price for sheet brass, 11.338 cents, by 3.19, one would have 36.169 cents per pound as the equivalent price for aluminum sheet, whereas the lowest selling price, with discounts off as shown in the latest aluminum price list, is 32.49 cents per pound.

From this it is evident that the selling price freely offered is at least 10 per cent. cheaper for aluminum sheet over the lowest selling price for similar brass sheet by anyone of the Association of American Brass Manufacturers.

But to this must be added the fact that an ordinary customer of brass is not able to obtain the maximum discounts allowed. It can be assumed that most purchasers of brass are paying a rate of 12½ to 13 cents per pound; and multiplying 12½ by 3.19 (the factor by which brass is heavier than aluminum) will give 39.875 cents per pound as the comparative selling price for aluminum; and multiplying 13 cents by 3.19 would give 41.47 cents per pound as the comparative selling price for aluminum.

The rates freely given by the Pittsburg Reduction Company according to their price list, for parties ordering considerable quantities of aluminum to replace brass, and who would order at least four tons per month, would be therefore at least 10 per cent. cheaper for aluminum than brass; and in many cases considerably cheaper still, relatively.

These are figures worth contemplating, the more so when one considers the tensile strength and conductivity of aluminum. The latter, to be sure, is only 60 per cent. of that of copper, in the form of commercial wire, yet weight for weight its conductivity, as compared with copper, is 2 to 1. While on the other hand the conductivity of brass is usually less than that quoted for aluminum. Leaving these questions aside, however, and considering the mere fact that sheet aluminum as shown above is cheaper than brass, area for area, who can foretell the limits of its ultimate expansion in the mechanic arts generally. This is only another example of the influence which electrical progress is exerting on the manufacturing industries of the world, and more specifically the influence of cheap power toward the same end. For it must not be forgotten that the prices above quoted have been made possible only by the employment of the cheap Niagara water power to which the aluminum industry was transferred but a comparatively short while ago. These influences have but just begun to manifest themselves and we make no doubt that as time passes further marked changes of condition will ensue in the industrial arts due to the causes above mentioned.

HUMORS OF THE MUNICIPAL OWNERSHIP SITUATION.

THE recent election in the Greater New York is not without some lessons in regard to the agitation for municipal ownership, a plank in favor of which appeared in the platform of more than one party. The abuse which these parties extended courteously to each other was such as to throw doubts on the honesty and sincerity of all of them, and here crops up one of the humors of the situation. Perhaps the utter absurdity of the municipal ownership propaganda is most clearly brought out by the New York "World," which, after blackguarding Tammany to the very extreme of its acknowledged ability in that direction, comes out the morning after election with a two-column editorial advocating the municipal ownership of water works, gas works, electric light plants and

street railways. In other words, it says: "You are a thief and pickpocket, my friend, beyond any doubt; therefore I will cheerfully entrust a great deal more of my property to your care." What would anyone think of such an argument or reason in the everyday affairs of life? What does Mr. Croker think about it, or that ardent municipal advocate, Mr. E. M. Grout, elected president of the borough of Brooklyn on the Tammany ticket?

Taking up the figures upon which the "World" bases its plea, they are found to contain the old gross fallacies and inaccuracies that have been exposed so often one wonders how people can have the face to go on repeating them. It is enough to confine ourselves to electric lighting and street railways. Here, for example, is the time-honored case of Dunkirk, which place we are told is furnishing electric lights at $39.54 per year, "just one-fourth the cost of the electric lights furnished in New York by privately owned plants." The superintendent of the Dunkirk plant has just reported that the expense of each light in October was 2.2 cents per hour, which at 3,000 hours per year would figure $66 per year, and at 4,000 hours would figure $88, to say nothing of the items omitted from the calculation of cost and nothing as to the enormous difference in rentals, wages, etc., between Dunkirk and New York City. Detroit, of course, is cited at $84.70 per lamp yearly, but her own figures, omitting insurance entirely and allowing only 5 per cent. for any depreciation on the whole plant, show an actual cost of $102.49. Chicago also is cited at the old figure of $96.40 per lamp per annum, whereas Prof. W. J. Meyers, in the "Political Science Quarterly," has already shown it positively to be $165.

The figures of street railway operation are just as valuable and trustworthy, and are limited to the "data" from Detroit and Toronto, neither of which city fortunately operates the roads, so that the public gets excellent service from private management. It is pointed out that the people get 3 cent fares, but as against the cheap travel due to the transfer system of the Metropolitan Company in New York, 3 cent fare is high. If the "World" wants to know what really cheap and luxurious travel is we recommend it to study President Vreeland's superb transfer system in this town.

The extent to which bribery is attempted of the people by politicians of the stripe inditing these articles in the "World" is shown by one of the circulars issued by a "National Democratic" candidate for assembly uptown. This gentleman was going to insure 3 cent fares, with no reduction of wages to the employés; and also proposed to put through legislation compelling every owner of flats and apartments to heat them not only in winter, but whenever heat was needed, under penalty. Why he did not propose free light also is not explained, but happily he failed of election. Next year he will pop up again probably with a bill to compel the landlord to furnish a free newspaper every morning at breakfast to every tenant.

ELECTRICITY IN SKIN AND METAL PURIFICATION.

THE newspapers have just been having a great deal to say in a loose and vague way about some experiments of Mr. Tesla, in which, by means of his high pressure currents, particles may be thrown from the human body. "It is thinkable or even very probable that a human body may in this way be rid of any extraneous particles that may be on it; and as the disease germs, if any, would be among these particles, the possibility and practicability of such treatment naturally suggests itself." Mr. Tesla says he has gone far enough in these experiments to suggest the possibility of enveloping the body in an actual sheet of ethereal electric flame without injury to the skin or nerves. This, however, is not by any means new, as the idea of "massage" with currents of high frequency was described by Mr. Tesla himself in The Electrical Engineer in December, 1891, when he said: "It is conceivable that a person entirely nude at the North Pole might keep himself comfortably warm in this manner." Not long ago Mr. Tesla stated that he had a plan for clearing trees of noxious bugs and parasites, a process evidently in keeping with that for cleansing the human skin. Another point of greater interest perhaps to engineers—though they are certainly interested in being clean and healthy—is the statement of Mr. Tesla that bronze paint on a brass ball can be torn off with great thoroughness, the violence of the action being so great that in time the brass itself will disintegrate. Now we all know how slow and troublesome are the usual methods of cleaning old paint off metal structures, and if Mr. Tesla will put in the hands of the engineering community a practical process of the kind hinted at he will have a further claim on their gratitude and probably make some money out of it. That all these nice things should be within reach and remain so long unattainable is rather tantalizing; but Mr. Tesla is more eager to get there than anybody else.

STEAM AT 3,200 POUNDS PRESSURE.

HAD any one suggested the idea embodied in the above heading only a short time back, he would have been ridiculed as an enthusiastic dreamer, but the fact that we are brought face to face with actual working apparatus operating at such pressures ought to make all users of steam pause to consider the possible effect on future power work. We are not unmindful of the fact that steam pressure as high as 500 pounds per square inch was employed by Perkins many years ago, but the reciprocating engine is conceded to be ill adapted to the utilization of such pressures, for reasons upon which we need not enter here. The steam turbine, however, puts no bar in the way to the utilization of any desired pressure, and the actual successful operation of the De Laval steam plant at the Stockholm Exhibition, described elsewhere in this issue, must set at rest all doubts on that score. While we have no test before us of the steam economy of the De Laval plant the known efficiency of the steam turbine would make it more than probable that it can well hold its own against our present methods of steam generation and its utilization in the reciprocating engine. But the important fact remains that the size of the plant required for a given output is enormously reduced by the application of such high pressure, while on the other hand the automatic operation of the De Laval system has much to recommend it. We are also without details as to the cost of the new system as compared with the present types of apparatus, but if it is in any way proportional to the diminished size, the mechanism ought to have a good future before it, and we shall probably hear more of it.

ELECTRIC CAR HEATERS.

THE approach of cold weather makes the consideration of the heating of cars one of prime importance to railroad companies. The electric car heater has met the conditions so well that it hardly seems necessary to offer apologies for any of its shortcomings. Nevertheless, we have thought it interesting to print this week a contribution in which the author shows the relative economy between the electric heater and the old car stove. No one, of course, will deny that considering merely the amount of coal consumed, the car heater may be more economical than the electric heater, but on all other points there can be no question as to the superiority of the latter. This is one of those cases in which collateral and real advantages far outweigh the disadvantages of apparently increased cost of new apparatus. Evidently the saving in coal is far more than counterbalanced by the increased seating capacity and the better distribution of the heat. Easy regulation to meet the changing conditions of the weather and the lack of attendance required have also helped to make it the favorite method of car heating. We dare say that electric railway companies would not go back to the old car stoves if the station coal consumption were twice as great comparatively as it is shown to be. Nevertheless, it is instructive to have these things pointed out, if for no other reason than to impress the public with the fact that electricity, even at an apparently higher cost, may prove more economical in the long run; and no better example could be cited than that of the electric car heater.

METEOROLOGICAL STUDIES.

WE publish this week a brief but pithy appeal from a distinguished meteorologist in behalf of the study of his specialty in our universities. It is, indeed, a singular fact that it should be necessary to address such an argument to instructors and to an educated public at this late day; but so far as we are aware, no chair of meteorology exists to-day in this country, although there may be something of the kind abroad. Few influences touch life and work more closely than the weather; no topic is more universal than the weather; but when we look for systematic, scientific study of this great subject at the chief seats of learning, it cannot be found. Perhaps this word in season from our public-spirited friend may bring about a change, and we shall be glad to have other readers co-operate to promote his ideas.

ELECTRIC TRANSPORTATION

CONSTRUCTION AND MAINTENANCE OF CAR BODIES AND TRUCKS.[1]

BY ROBERT DUNNING.

As the life of a car body depends almost entirely upon the bottom framing, nothing but well seasoned and perfectly sound, straight grained timber should be used. Ordinary kiln dried lumber is not suitable for car framing, and even when timber has been in the drying shed for a long time it should be given a couple of weeks seasoning after its first working, for well dried timber will show a slight shrinkage after being worked. Too much care cannot be used in the cutting of mortises and tenons to see that they are tight all the way round and all the way through. The placing of cross sills will be influenced somewhat by the style of car, and motor equipment, and there is probably nothing better than strong diamond bracing to hold the frame square. Lead the mortises and tenons, and when the frame is driven together, put in the tie rods, draw up tight and put on corner plates and finally square and level up the whole work.

The end and side framing should be assembled with the same care and set up in solid sections on the bottom framing, and lastly put the roof framework in place. Avoid splicing and do not use two short pieces where one long one can be made to do the work. Secure all corners inside and out with light steel angles and where possible the inside and outside angles should be held in place by the same bolts.

The present tendency in painting is toward simplicity as to colors and ornamentations and is certainly to be commended from a practical standpoint. The use of a few colors and those that do not fade quickly make retouching easy and satisfactory and reduce the cost of painting very materially. The neat effect of natural wood finishes in the inside of the car is also to be commended for beauty and long wearing qualities.

In truck construction we have nearly as many patterns as there are of life guards and each maker claims to embody some principle which no other truck has, and all other trucks are therefore fatally defective. With one the great principle of a perfect truck lies in the bearings, with another it is in the frame; another the springs; another the amount of traction, and so on, with additions, subtraction, multiplication and divisions, and the end is not yet. Taken collectively the truck builders have wrought a great work, and when the day comes that produces a truck in which each of the principles they claim is brought to the perfection they now claim in each instance, we can cease our looking for improvement in that direction and reflect complacently that Solomon was certainly mistaken when he said that there was no perfection under the sun. As it is we must be content with the knowledge that there is one best truck on the market and though each maker claims it is his, we still have the privilege of choice and can act accordingly, even to experimenting a little ourselves when we feel like exploiting a pet theory. The ideal truck is the one which gives the maximum amount of traction, rigidity of frame, flexibility of operation, ease of running and the minimum amount of oscillation and weight. These and many minor principles go to make the perfect truck. How to attain them is the study of every mechanical engineer in the street railway business, and some outside. To enter into a discussion of the principles involved is impossible in this paper, as any one of them would require a long article, which time forbids, so we will pass on to the maintenance of cars and trucks.

A car in regular service should be revarnished once in nine months, or oftener if the locality in which it operates is subject to conditions which are specially injurious to varnished work, such as an excessive amount of smoke and coal gas in the atmosphere. Before retouching and varnishing have the joints of the car inspected and if any indication of shrinkage or working is shown see that it is put right.

In the truck, besides the painting and varnishing, other conditions are to be met, for here the wearing parts demand constant attention and should be gone over every time the car is run into the house. You cannot depend upon the driver or conductor to always report defects even though they are ordered to do so; their mechanical knowledge may be very limited, and as long as a thing works it is all right to them. In the matter of brake shoes see that the shoe sets true upon the wheel and is in perfect contact on the whole face.

In the matter of flat or skidded wheels, we all know the causes; we also know many remedies for the trouble and have applied them, but the wheels continue perversely to skid, and will probably continue to do so as long as the braking power is applied to them and emergency stops are made. The regular sanding of the track has probably done as much good as anything that has been tried so far, but for the present there seems to be nothing better than to get as high a mileage contract as possible from the wheelmaker with the necessary regrinding included.

To the electrical equipments, all the previous remarks relating to testing and careful inspection apply with double force. Insulation is another point to be carefully scrutinized and the careful and solid connection and securing of the various parts is another. A loose wire if not attended to means damage sooner or later, and a poor connection loss of power and possible burning. Some roads advocate the taking apart and thorough overhauling of motors and controllers once a month. This would seem to be somewhat oftener than is actually necessary and it would be an extraordinarily severe service that would require it. The chance of doing damage to electrical apparatus while it is undergoing an overhauling is quite a factor and it would seem to be more reasonable to use judgment in this matter than to take the apparatus out and put it back at regular periods without regard to other conditions.

CAR HEATING.

BY GEORGE B. DAMON.

The question of heating street cars electrically comes up at the beginning of each winter for discussion. It is no small item for any street railway company to supply about 6 h. p. for heating purposes to a box car that seats 24 people. It might be of interest to show why it takes that amount of power and how it is expended. For that purpose it will be necessary to recall a few facts that do not properly belong in the realm of electrical engineering.

The specific heat of air is .2377, compared with water = 1 at 32 degs. F. That means that if 1 British thermal unit will raise the temperature of one pound of pure water 1 deg. F. at and near its greatest density, which is at 39.1 degs. F., the same quantity of heat, or 1 British thermal unit, will heat one pound of air $\frac{1}{.2377} = 4.2$ degs. F., or 4.2 pounds of air 1 deg. F.

One pound of air at 32 degs. F. and under atmospheric pressure contains 12.387 cubic feet, and air, the same as all the elastic fluids, expands uniformly between 32 degs. F. and 212 degs. F., .00209 of its volumes for each degree F. The range of temperature which will be considered hereinafter is so limited, however, that we can safely assume that one pound of air contains 12.4 cubic feet without causing any serious discrepancy in the result. Therefore, 1 British thermal unit will raise the temperature of $4.2 \times 12.4 = 52.08$ cubic feet of air one degree.

It has been ascertained by experiment that one square foot of ordinary window surface will cool 1.279 cubic feet of air as many degrees per minute as the temperature inside the room exceeds the temperature outside. It is also a fact that a person needs about five cubic feet of air per minute for respiration.

Bearing the above facts in mind, we can now determine what quantity of British thermal units is necessary to heat a car that seats 24 people and has 100 square feet of window surface, when the temperature outside is 0 deg. F. and the car is to be heated 60 degs. F.

The window surface of the car will cool $1.279 \times 100 \times 60 = 7,674$ cubic feet of air 1 deg. F. per minute and the 24 passengers require $24 \times 5 = 120$ cubic feet of air per minute heated to 60 degs. F., which equals $120 \times 60 = 7,200$ cubic feet of air heated 1 deg. F. per minute. We will therefore have to supply an amount of heat which will raise the temperature of $7,674 + 7,200 = 14,874$ cubic feet of air 1 deg. F. per minute.

We found that one British thermal unit will raise the temperature of 52 cubic feet of air 1 deg.; consequently

$$\frac{14,874}{52} = 286.03 = \text{number of British thermal units that have}$$

to be supplied per minute to furnish the necessary heat.

One British thermal unit = 778 foot pounds (Joules) and the mechanical equivalent of 286 British thermal units would be $286 \times 778 = 222,508$ foot pounds per minute and $\frac{222,508}{33,000} = 6.743$

[1]Abstract of paper read before N. Y. State St. Ry. Assoc.

h. p. would be the equivalent h. p. rate. The electrical equivalent would be $6.743 \times 746 = 5{,}030.278$ watts.

In the equation $P = I^2R$ (Joule's law) we have the rate at which energy is expended by the current I in the resistance R. In the equation $P = EI$ we have the power expended in the circuit. In a 550-volt circuit $\frac{5{,}030.278}{550} = I = 9.146$ amperes; and $\frac{5{,}030.278}{9.146^2} = R = 60.13$ ohms; which means a current of 9.146 amperes forced through a resistance of 60.13 ohms with a pressure of 550 volts will do work, which appears in heat, at the rate of 5.03 k. w. and will heat a car that contains 24 people and has a window surface of 100 square feet to 60 degs. F., the temperature outside being 0 deg. F. As will be seen, this corresponds very closely with present practice.

We will now consider the amount of fuel and efficiency of electric heating compared with direct heating by stoves.

In the more modern power stations 1 k. w. hour can be generated and delivered to the lines with 2.5 pounds of coal. Therefore $5.03 \times 2.5 = 12.575$ pounds of coal per hour must be burned in the boilers of the power station to supply heat to one car under the above conditions for one hour. For convenience we will reduce the comparison to 1 k. w. hour. One k. w. hour will heat $\frac{14{,}874 \times 60}{5.03} = 177{,}423$ cubic feet of air one degree per hour. Assuming that each pound of coal contains 12,000 British thermal units then $\frac{177{,}423}{52} = 3{,}412$ British thermal units, which perform work in the heater, against $2.5 \times 12{,}000 = 30{,}000$ British thermal units, which were necessary to generate 1 k. w. hour.

The efficiency of electrical car heating would be $\frac{3{,}412}{300} = 11.37$ per cent. In other words, in the car heater, under the above conditions, we put to use 11.37 per cent. of the potential energy of the coal burned in the boilers of the power station.

Assume that an ordinary stove, such as used for car heating purposes, radiates 60 per cent. of the heat generated by the coal burned therein, and assuming that the coal burned in that stove had the same potential energy as that burned in the boilers at the power station, then $12{,}000 \times .6 = 7{,}200$ British thermal units would be the useful heat radiated by the stove with one pound of coal and $\frac{3{,}412}{7{,}200} = .474$ pound of coal burned in the stove would do the same heating that 2.5 pounds do burned in the boilers of the power station, or it takes $\frac{2.5}{.474} = 5.27$ times more fuel to heat cars electrically than it takes to heat them by stoves.

MOUNTAIN RAILROADING IN SWITZERLAND.

Only twenty-six years have elapsed since the railway was built up the Rigi, and to-day Switzerland has forty-six mountain railroads. The most popular of them at present is that up the Wengern Alp, from Interlaken via Lauterbrunnen or Grindelwald. A few years ago there were only a few small hotels near Wengern; this summer 700 guests jostled each other in the new hotels, while some of the other resorts complained of a lack of tourists. The Wengern Alp owes its present vogue not only to the wonderful view it affords of the Jungfrau snowfields and frequent avalanches, but to the fact that it is the starting point of the much-discussed Jungfrau Railway (already illustrated and described in The Electrical Engineer), the length of which, from the Scheidegg, is conveniently reduced to 6,000 feet. On December 21, 1894, permission to build it was granted by the Swiss Bundesrath by a vote of 25 to 3. No time was lost in beginning, and this summer the electric works were visible to all visitors in the Lauterbrunnen valley. The road itself will not be visible, for most of it will be through tunnels, and where it comes to view it will be so small an object on the gigantic sides of the mountain that a good telescope will be needed to find it. The motive power will be electricity, and the tunnelling also will be done with electric power. The total expenses are estimated at $2,000,000.

UNION COUNTY, N. J., is discussing a plan of a municipal trolley system along Westfield avenue, from Elizabeth to Plainfield, a distance of eleven miles, to cost $350,300.

LOW JOINTS.—HOW TO PREVENT THEM.[1]

BY C. LOOMIS ALLEN.

NEARLY every street railway company has a stretch of poor track, which for good reasons it is trying to use for a term of years, or until such a time as it is possible to rebuild with what is now called "permanent construction," and the greatest of the trackman's troubles in keeping this track in a condition for the operation of cars is the joint.

In Syracuse, last fall, during our reconstruction, we had a street 4,500 feet long, in which were double tracks. The structure was a 47-pound stringer rail upon 5x7-inch pine stringers, the ties supporting the stringers every five feet. It was our aim to save as much of this structure as possible and yet have a track structure in the street which would survive a period of five years' traffic. At the end of that time it is hoped that all the sewers, water, gas and conduits will be in the street so that permanent construction can be built without being ruined during the process of construction of these underground structures.

The paving was removed and the stringer rails consigned to the scrap heap, the stringers and ties lowered 2½ inches below the original grade. Ties were introduced between those under the stringers so that the spacing under the stringers was 2½ feet between centers. To the stringers were spiked the Johnson Company's 66½-pound girder rail which had been removed from track by reason of failure at joint. This rail had been laid on chairs and had become so worn at the joints that it was doubtful whether it could be used; but, aside from the deflected ends, the rail was in good condition and not worn out. The ends of a great many of these rails were tested for deflection previous to laying, and in many cases 3-16-inch deflection was found. What effect traffic would have upon the ends of the rail after placing upon them the Weber joint was a result that was awaited with much interest. This joint was purchased with the idea of benefiting the rails, bringing them up to grade and in proper line. The rails were laid with broken joints with rail ends butted tight. No trouble was encountered in placing the joint, and the track structure was completed and paved in. It was our intention at the time of construction to operate on the track a day or two previous to replacing the pavement, and then to tighten the bolts once more firmly. The conditions of traffic would not allow this and the structure was paved in without this second tightening.

At first the cars which were operated upon this track pounded considerable at every joint. As the construction of this track was completed just before the final freeze-up last fall the pounding was made more prominent by reason of the frost holding the track structure firmly.

In the spring, after the frost had left the ground, the rails were examined, and although no metal was restored to the head of the rail the ends of the rail had been brought up to grade and line. The bolts of some of these joints had become loosened so the paving blocks were removed at the joint and the bolts thoroughly tightened. This track is not as good a track as our standard 9-inch construction, but we have saved from the scrap heap rails that, without the use of these joints, could not have been used as relaying rails. This construction, we believe, will do the work we expected of it, i. e., the carrying of traffic for a period of five years.

During the past four years girder rails 9 inches in height, with brace plates and with joint plates of varying dimensions as to thickness and length, have been considered standard material for permanent construction, but the joint is still the weakest portion of the track structure.

Three things that are important in the solution of the joint question are as follows: 1. Materials used in track construction. 2. Manner of supporting the rails. 3. The location of the joints in relation to each other.

In the purchase of track material for 9-inch construction if the rails are all that are considered, and the selection of a suitable joint for the rail is passed upon lightly one would naturally buy that which would give to him track material at the lowest cost per foot of single track, i. e., the joint would be the cheapest joint purchasable. The other appurtenances aside from the rail would receive like treatment. But if, on the other hand, a good track structure throughout is desired, with a minimum cost of maintenance after the track construction has been turned over for operation, due consideration will be given to all track appurtenances before final decision is made to purchase cheap material.

The support of the rails along the entire length is just as important as for the rail to be well supported at the joints. The greater the number of lineal inches of tie-bearing supporting the rails when the ties are well ballasted and tamped, the

[1]Read before the N. Y. State Street Railway Assoc.

longer the life of the track structure. To give good support to the rails, ties should be placed as close together as it is possible to do so and yet give room to properly tamp with the tamping bars the ballast supporting the ties.

The manner of fastening the rails to the ties should be carefully considered. Spikes that will give good holding power and not split or cut the ties so as to injure them should be selected. The joints in the rails upon either side of the track should not be opposite each other.

Rail ends of the same section very frequently show, upon being calipered, that there is a difference in their height and when two ends like this are united by the joint a pound or blow will result at this joint causing a weakness upon that rail of the track. If another joint is laid immediately opposite upon the same ties supporting the poor joint, no matter with what care or in what condition the joint when laid may be, this pound or blow will have its effects upon the good joint and it will not be long before two weak spots will appear in the track where, if the joints had not been laid opposite each other, there would have been but one; on the other hand, if the joints be laid broken the pounding is transferred by the axle of the car, not to the weakest spot on the opposite rail, i. e., the joint, but to the solid portion of the rail. The cost of maintaining to proper grade and line, track laid with broken joints is not so great as track having joints laid opposite, as when once repairs are needed the latter will require attention a greater number of times. In the construction of permanent track today street railroads have the joint question to face only half as many times as they did three years ago. Sixty foot rails have cut the joint question in two.

We are laying in Syracuse the following construction at the joint, and from it have had no trouble: The joints are laid broken, with rails butted tight. Corrugated joint plates 9-16 of an inch thick and 36 inches in length are bolted tight by means of twelve 1-inch bolts, the nuts of which are held in place by the Young gravity nut lock. The ties at the joint are laid to form what is known as the three-tie joint; the centre tie supports the rail ends equally, and the other ties are laid so that the ends of the joint plates are supported upon the centre of the ties, thus giving three ties supporting the rail underneath the joint plate. The spacing under the rails, aside from the joint is 1 93-100 feet between centres of ties, giving thirty-two ties to every 60 feet of track. The ties used are Southern yellow pine, 6 inchesx8 inchesx8 feet, and they are supported by eight inches of broken stone ballast.

THE ADVANTAGES OF A CAR MILEAGE RECORD.

BY T. J. NICHOLL.

WITH the object in view of having, as near as possible, an absolutely correct system of computing the mileage, my company has spared no effort, with the result that the system now in force works to perfection, and answers our requirements in every detail.

We operate 78.73 miles of track in the city, covering an area of about eighteen square miles. Some of our routes are quite intricate, and on part of them we have as many as six turning points where we can turn part of our cars, as the traffic on the balance of the line may not warrant the same service as nearer the city. In some instances our cars run on several different lines during one day. Our average daily mileage is between 13,000 and 14,000 miles, or about 5,000,000 miles annually.

In the first place, our engineers made a very careful survey of each line, and mapped same out to the scale of 400 feet to one inch. These maps show all switches, cross-overs, junctions, cross streets, etc., and the distances are given from commencement of the line to all points where it is possible to turn. From these maps we have figured tables for any specified number of trips or half trips in either direction on each route. Each motorman makes report of the number of trips made by his car daily, on a card which answers a three-fold purpose. In addition to giving the number of trips made, it answers as a time card and also as a trouble report.

Any motorman taking out a car makes out one of these cards which he hands to his relief, and the man pulling the car into the barn drops this card into a box provided for the purpose. The night foreman has access to this box, and from the reports finds out all repairs necessary to be made, and anything he is unable to complete he reports to the day foreman. Every motorman is advised of the importance of having his trips, time, etc., correct, and is required to account for any trips lost and also to report any defect which he may notice about his car, and if he fails to do so is held strictly accountable.

The trip cards are checked with the starter's report, so that no cards can be left out; also the time of leaving barn and pulling in must agree, and there s no chance of any one getting more time than is actually put in, as the time a man leaves the car must agree with the time his relief takes it.

From these trip cards the mileage is figured by routes, the mileage for each car being put down separately on the slip. The individual car mileage is then posted daily to the credit of each car in a book provided for the purpose, and the amounts are carried forward monthly, so that when we want the mileage of any article we have only to subtract the mileage at the time the same was put into service from the total mileage made by the car on which it is used, at time it comes out.

The route mileage is posted up daily in a book provided for this purpose, and in this way we get the mileage for each for the month or year; the earnings are also shown on this book. A daily report is made for the manager, which shows the mileage and earnings on each line, also weather, etc. It also gives the corresponding figures for the previous year.

A monthly mileage, earnings and passenger report is also rendered. This furnishes a comparison between the current and previous year, for each line. It shows the mileage, total earnings, earnings per car mile, passengers and transfers. It also shows the increase or decrease, as the case may be, and affords an excellent guide in regard to service that should be provided for each line, and we can thus keep each individual route up to a standard. From the figures on this sheet many valuable statistics can be deduced, especially in reference to traffic, etc.

On our monthly mileage statement we figure all the various operating expenses per car mile, showing also the corresponding figures for the previous year, and thus we have a very good comparison of results. We also keep records of the cost of repairs per mile on the various equipments in use; also of the life of car wheels and other parts of an equipment. In short, from the mileage we obtain most interesting statistics in almost every branch of the business.

[1]Read before the N. Y. State Street Railway Association.

THE TROLLEY IN CONNECTICUT.

A new region of Connecticut where trolley and steam interests are likely to clash is between Springfield and Hartford, a distance of about eighteen miles. The Springfield and Southeastern Trolley Company has already graded its line to Suffield, to which the New Haven steam railroad has a branch. The plans of the trolley company and of the Hartford Street Railway Company involve connections and extensions via Windsor Locks, which, unless blocked in the courts, with operating roads, will close the small gaps now breaking a continuous parallel between Springfield and Hartford, in a region which has fed the New Haven company considerable local traffic. That traffic has, however, been considerably impaired by already existing trolley lines.

The results of trolley competition with the New Haven Railroad system are suggested by a fall, during the last fiscal year, in the total number of passengers carried to 41,599,670, as compared with 43,970,932 during the year before, the average distance per passenger carried rising to 18.19 miles, as compared with 17.93 miles the year before. The losses, however, were probably larger both in Rhode Island and Massachusetts than in Connecticut.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION.

The above association has recently been formed out on the Pacific coast, with an initial membership of ten local companies, and under the presidency of Mr. E. B. Gilbert, of the Sacramento Electric, Gas and Railway Co. The meeting was held at Sacramento, when various technical topics were taken up and discussed.

THE LORAIN & CLEVELAND RAILROAD.

This road, described and illustrated in our issue of October 14, has been in regular operation since October 6, with cars running on a regular hourly schedule.

The cars take three quarters of an hour from the square in Cleveland to Rocky River, which is the beginning of the private right of way, and three-quarters of an hour from there to Lorain. Owing to a sewer being built in the city portion of the run, cars have, at times, been delayed, and when running on the private right of way they have made over fifty miles an hour, when desired, and running on the regular schedule over forty miles. The cars are under perfect control and the electric brake operating on all four axles enables the car to be stopped within a short distance, and without a jar. The full load of the generator is 530 amperes; the load it is called upon to take has varied from zero to 800 almost instantaneously, and from 800 to zero instantaneously, and has run at over

700 amperes for considerable periods of time; the operation of the generator under such condition has been very satisfactory. A second generator is in course of installation. The engine also has shown good regulation, and the steam furnished to the engine has been dry, even with the greatest fluctuation of load.

SHORT GEARLESS MOTORS FOR THE CENTRAL LONDON UNDERGROUND.

The Central London Underground Railway, now being equipped for electrical traction by the British Thomson-Houston Company, will be, undoubtedly, one of the most modern and interesting plants of this character in existence. The electric power is to be furnished by large alternating generators and distributed at high pressure to substations located at intervals along the line where the potential will be reduced by means of step-down transformers and converted into direct current by rotary transformers which deliver it to the third rail.

The motors are to be the spring-suspended gearless machines invented by Prof. Sidney H. Short, and will be similar to those which have been used so successfully for the past two years on the tunnel locomotives of the Baltimore & Ohio Railroad. Prof. Short has assigned his English gearless motor patents to the British Thomson-Houston Company.

There is but little doubt that the gearless motor will come into general use as heavy, high speed electrical traction develops, for already the gear ratios of single reduction motors are rapidly approaching one to one for high speed cars.

ELECTRIC LOCOMOTIVES FOR THE BALLSTON SPA, N. Y. TERMINAL RAILWAY CO.

The Westinghouse Company are equipping for the Ballston Terminal Railway Company, Ballston Spa, N. Y., four 50 h. p. standard railway motors, to be mounted on the axles of the locomotive trucks. By this method the total weight of the locomotive is utilized for traction, each wheel being a driving wheel. The total weight of the train is estimated at 165 tons, the total weight of the locomotive being 30 tons.

The total tractive force, or draw bar pull of the locomotive will be 11,500 pounds, at 8.5 miles per hour; that is to say it will be capable of moving a train of 165 tons at 8.5 miles per hour up a 2.5 per cent. grade. The total length of the locomotive is 46 feet 6 inches.

The Westinghouse Company have equipped the Ballston Company's power house, and are also furnishing them another locomotive somewhat smaller in capacity. The locomotive car body and trucks have been furnished by the J. G. Brill Co., of Philadelphia.

MECHANICAL

THE PROPER CONSTRUCTION AND USES OF ECONOMIZERS.[1]

BY HENRY G. BRINCKERHOFF.

THE principle of heating the feed water in a separate vessel, quite apart from the boiler, and thereby utilizing the heat in the waste gases, is the function of flue heaters, more commonly called economizers, leaving the boiler to supply chiefly the heat units necessary for the latent heat of steam. Taking the important steam users throughout the world, this is a recognized and universally adopted practice. Economizers are not only considered a necessary part of the equipment of every steam plant in Great Britain, but are in operation all over the Continent, and as well known in the spinning mills of Russia and India; equally noted among the gold mines of South Africa and the textile factories of China and Japan; while throughout the large manufacturing districts of the United States they are already extensively adopted.

The great loss of fuel as noted between the heat value of coal and the heat taken by the water has been observed for many years, and numerous have been the appliances to recover it, the simplest and best appearing to be to pass the waste gases on their passage to the chimney through pipes containing water, and thousands of such pipe heaters have been constructed by nearly as many makers, yet with the exception of one or two they have all failed. Disappointment has attended the result of so many economizers or flue heaters that we find that some people have become skeptical and condemn them all, and state it to be impossible to build one which will last and give satisfactory results.

The failure of so many flue heaters is attributed to three causes:

1. Not being made of cast iron, the only practical metal to withstand the corrosive action of sulphurous gases.

2. Lack of capacity. It takes time to absorb enough heat to make them of practical value, hence the water should be from 30 to 50 minutes surrounded by waste heat.

3. Lack of automatic cleaning of pipes. Soot being a non-conductor of heat, a slight coating on a limited capacity economizer would end its usefulness in a few hours after it had been thoroughly cleaned.

The late Edward Green was the first to develop a flue heater embodying these essential features, and a word as to this well known inventor and the business he established will be of interest. Edward Green was born in 1799, in Wakefield, Yorkshire, and died in the year 1865, and was succeeded in the business he founded by his son, Sir Edward Green, Bart., the present head of the firm, who was joined by his second son, Frank Green, in 1883. Before the late Mr. Green began to devote his whole time and energy to the apparatus that bears his name, he was engaged in general mechanical work and in the construction of large pumping engines for the deep coal mines of Yorkshire as well as others for draining the fens in Lincolnshire and Norfolk.

Though the patent for his fuel economizer was taken out in 1845, it was not until after the great exhibition of 1851 that steam users seriously recognized the great opportunity for saving that was, by its means, placed within their reach. From that date, however, its success was assured, and the large amounts of coal economized by those steam users who gave it a trial forced it upon the attention of the remainder of the manufacturing community, with the result that the advantages of the economizer became more and more widely known, and at length almost universally recognized, so in the present day the invention is used by boiler owners all over the globe.

Briefly stated, the further and most important details for a well designed economizer should be the absence of all "made" or packed joints inside of the brick work; easy accessibility to every square inch of internal surface; the vertical pipes should be forced into the top and bottom headers by powerful hydraulic pressure, making the joints metal to metal, which is a far superior piece of workmanship than fitting the pipes in loosely into the boxes or headers and then rusting in by the use of iron filings and sal ammoniac. Finally, applying a rigid test to each section of 350 pounds to the square inch.

A well constructed economizer built under the specifications described should last twenty years under ordinary care and attention. After it has reached that age it can be easily repaired and parts renewed so as to last indefinitely, as an umbrella retains its original individuality which has been fitted with new stick, spokes and re-covered. The care required consists in blowing off daily at the same time as the boilers. Every three months the soot should be cleaned out of the chamber below, which at such an interval is about an hour's job. Once a year, at least, the caps should be taken off and the interior of the pipes inspected. If the water is bad this should be done often. There is no reason why the scraper mechanism should not run smoothly for years. This used to be a troublesome point with some of the early makes of economizers.

The general use of compound condensing engines in modern steam plants has enlarged the field and extended the use of economizers, as the exhaust steam is not available for heating feed water except to a limited degree. A common practice some years ago was to take a portion of the exhaust steam for heating feed water, obtaining thereby a temperature of about 210 degrees, while with the compound condensing engines it is not generally feasible to get much over 130 degrees, thus making a direct loss in economy for the compound plant as compared with the older ones, to the extent of 7 to 10 per cent. of all the coal consumed, offsetting to that amount the gain obtained by compounding, whereas the higher temperature of the steam demands a higher temperature of feed water, instead of lower, for the proper efficiency and durability of the boiler.

The advantages of the economizer may be summarized as follows:

1. It is a bona fide saving of an actual waste.

2. It increases the capacity of the boiler plant.

3. It saves repairs to the boilers by relieving them of much of the strain of expansion and contraction caused by colder water entering the boilers and mingling with the hotter contents.

4. It prolongs the life of the boilers for the same reason.

[1] Read before the New England Cotton Manufacturer's Association.

5. Saves much cleaning of the boilers, thereby increasing their efficiency because of the precipitation of feed water impurities in the economizer, many impurities not being freed from the water until a high temperature is reached. This fact, and the slow movement of water in the economizer, is the reason that this apparatus removes so much more foreign matter from the feed than the other types of heaters.

6. The economizer is especially desirable where the work fluctuates. A large amount of power suddenly withdrawn drops the boiler pressure, while fresh coal in the furnace and cold feed water entering the boilers make matters worse, a condition frequently observed in bleacheries and electric plants. Gauge pressure is seldom observed to drop when an unusually large amount of feed water is being forced into the boiler, where is has been previously heated in an economizer.

7. Any use hot water can be put to in processes of manufacture can be obtained free of cost by drawing the pure hot water from the economizer; particularly bleachers and dyers take advantage of this opportunity for their kiers and dye tubs. Where mills are heated during the winter by hot water, a part of the economizer can be included in the circulating system, supplying the heat necessary, entirely by the waste gases. This has been done by some large mills, the Grosvenor-Dale Company, a good representative of our New England textile mills, being one of them.

In conclusion, I may say it is the general opinion of those owning economizers and others having them in their charge, that it makes easy working conditions in the boiler room.

PERSONAL

P. B. DELANY.

P. B. Delany

The subject of high speed machine telegraphy has been made very familiar of late to the American public by the work and arguments of Mr. P. B. Delany, whose portrait is shown herewith. This gentleman was born in Kings County, Ireland, in 1845, came to this country when nine years old, and at the age of 16 became a good operator. While press operator at Worcester, Mass., about two years later, he made a high record for skill, speed and accuracy as a receiver. In 1865, being then only 20, he became night circuit manager at Albany for all wires between New York and Buffalo. His next steps of promotion were chief operator for the Franklin Telegraph Company at Philadelphia; assistant general superintendent of the Southern and Atlantic Telegraph Company and superintendent of the Automatic Telegraph Company. Being always a brisk and versatile writer, as well as a man of wide reading and observation, he received many inducements to engage in newspaper work, and did for a time act as correspondent at Washington, besides becoming editor of a paper at Harrisonburg, Va. But his numerous inventions in the field of electricity drew him back to his former pursuits, and he has remained active in telegraphy, as inventor and expert, ever since 1880. His chief contribution to the art is probably the synchronous-multiplex, which has won him many awards, and which has been extensively introduced in England by the Government Postal Telegraphs. Of late he has been engaged with improvements in cable signaling, with the object of sending Morse over long submarine cables; and he has also brought forward a highly ingenious apparatus, already noted in these pages, to cheapen and popularize machine telegraphy, so that many letters may go by wire that now go by mail. Mr. Delany's patents number between 100 and 150, and he is constantly at work in a laboratory he has carried on for some years at South Orange, N. J. Mr. Delany is a valued contributor to these columns and others, and has been an active and useful officer and member of the American Institute of Electrical Engineers, in whose proceedings he shares frequently. Mr. Delany's son is also following the profession of electrical engineer.

MR. W. G. BOND has severed his connection with our London contemporary, the "Electrician." He joined the staff in April, 1888, and became editor in 1895, upon the retirement of Mr. A. P. Trotter, now electrical adviser to the government of the Cape of Good Hope colony. Mr. Bond has made an excellent editorial record and won a great many friends by his work.

DR. C. R. DICKSON, of Toronto, is the new president of the American Electro-Therapeutic Association. The next meeting of this body is to be held in Buffalo in September, 1898.

MR. E. E. COOMBS has been appointed general manager of the electric railroad at Kansas City, Mo., to fill the vacancy caused by the resignation of Mr. L. M. Erb.

MR. C. W. STEVENS, lately superintendent of the Chester & Derry Electric Railroad, has been elected superintendent of the Exeter & Hampton Beach Railroad.

MR. J. M. UPTEGRAFF has again become superintendent of the Sewickley, Pa., Electric Company, vice John Van Cleve, resigned.

MR. S. M. HAMILL, JR., of the Brush Electric Co., is to be seen quite often in the electrical haunts of New York and follows with much interest the developments in the lighting industry, a field where his expert practical experience through so many years has given him a large circle of acquaintance and influence. When in town last week Mr. Hamill expressed himself as satisfied with the outlook for the future of electric lighting and predicted a more rapid expansion than had yet been seen.

ROENTGEN RAYS

X-RAY SOLARIZATION.

Direct solarization effects have been obtained by W. L. Robb with intense X-rays and described in the Amer. Journ. Sci. Portion of a photographic plate was covered with one layer of commercial tinfoil about 5 cm. square and 0.0015 cm. thick, and the central portion was covered with 32 additional layers of the same foil about 2.8 cm. square. Exposures of 2.5, 5 and 15 minutes gave markedly different results. The centre portion was always white in the negative. With the short exposure, the single layer was somewhat lighter than the bare plate. At 5 min. the single layer disappeared and at 15 min. it was actually darker than the exposed portions, these having become reversed or "solarized" by prolonged exposure. A flat cone of aluminum similarly exposed showed the greatest blackening just within the circular rim.

ROENTGEN RAYS IN THE LIGHT OF THE FIRE-FLY.

Prof. H. Muraoka, who holds the chair of physics at Kyoto, Japan, has been making investigations into the properties of the light emitted by fireflies.

His method was to place from 300 to 1,000 of these insects in a small flat box under a net made of hemp. The box also contained a photographic dry plate between which and the fireflies Prof. Muraoka placed various substances composed of metal, paper and wood. After wrapping the box carefully with several thicknesses of black paper he would leave it for two nights in a photographic dark room, from which all sunlight and artificial light was carefully excluded.

From his experiments the Japanese professor found that the light of fireflies possesses all the properties of ordinary light. In addition he found that rays are given out which resemble those of the Röntgen ray in their power to penetrate paper, wood, metals and similar substances. However carefully he wrapped the sensitized plate before placing it in contact with the fireflies, it was always more or less blackened by their light. A very marked resemblance was found in these rays to the light of fluorescent bodies, as shown by recent investigations by M. Becquerel.

ORANGE, N. J.—A trolley conductor on receiving five cents in coppers from a young lady recently, threw the pennies into the street, was reported and was discharged. His excuse was that he had 91 cents already, and was bowed down by weight of woe in the shape of copper, and had paid the fare out of his own pocket.

LEITUNGSDRAEHTE UND KABEL. By Hugo Wietz. Oscar Leiner. Leipzig, Germany, 1897. 5½x8½. Paper. Price, $2.80.

With the general advance and improvement in electrical apparatus during the last twenty years, good time has been kept by the conductors employed for the distribution of current. Unfortunately the advances have not become so generally known as they might be, and, indeed, the record has been scattered about in many periodical publications, so that a general survey of the subject is by no means an easy task to one who would inform himself of the present state of the art. Taking this view of the subject, the author has got together a treatise on the manufacture, laying and maintenance of conductors and cables, which, while possibly not all-embracing in its comprehensiveness, is nevertheless valuable as representing the present state of the art. The work is divided into three parts. Beginning with a short historical review of the subject, inclusive of the statistics of cable work throughout the world, the author takes up the manufacture of insulated wires and cables and treats successively of the metallic conductor, the stranding and the other manipulations previous to the application of insulating material. Insulation then comes in for consideration, under which the various processes of covering, taping, impregnation, etc., are described in detail. In the same manner the various cable armor processes are illustrated, and the reader is greatly aided in his understanding of this process by numerous illustrations and diagrams of machinery. The author follows the same method in regard to the manufacture of the ordinary insulated wires, telegraph and telephone cables and cables intended for heavy high tension currents.

GAS CONSUMPTION IN THE UNITED STATES AND CANADA.

IN his annual address delivered before the American Gas Light Association, President Nettleton embodied a number of statistics relating to gas consumption in the United States and Canada as follows:

There have been several times in the past few years when I would have been very glad to have known the average amount of gas sold per capita throughout the country, but I did not know where to obtain accurate information on the subject. Thinking that perhaps others might be in the position to need this information as well as myself, I determined to incorporate it if possible in this address; and to that end I have sent out within the past few weeks over 700 letters to gas companies in this country and Canada, stating my object and requesting a reply to the series of questions enclosed. Of that number about 400 have sent replies, and of these I have been able to tabulate 384.

In arranging the replies I have divided them into three classes: Places under 20,000 population in the first; 20,000 to 100,000 in the second, and 100,000 and over in the third. The averages of 230 places are given in the first; 130 in the second, and 24 in the third, and are as shown.

All the averages, except those contained in line No. 13, are made up upon the basis of the number of towns in each class. I desire to call your attention to a peculiar circumstance that the average amount received per meter (line No. 10) is between $32 and $33 in all three classes. This may be purely accidental, but I am inclined to think that this amount represents the average amount that can be collected per meter. The sales per capita (line No. 11) increase very rapidly with the population; and if another class had been made of cities of over 500,000, I am confident that the sales per capita would have been very much larger than in the other three; but there were so few replies received from cities of this size that it would probably have been misleading to have done so with the information in my possession. In the preparation of this matter, I have naturally given it considerable thought, and it has seemed to me that the sales per capita did not express the information we were really seeking. While the gas sold per capita is interesting, and for the purposes of comparison instructive, yet that quantity is, of course, affected to a greater or less extent by the price charged; and the real thing, the keynote of this particular subject, is the amount of money received per capita—the gas sold multiplied by the price charged—and you will notice that I have given averages on this point (line No. 12), and they also increase with the population, although the price is lower in the larger places. I desire also to call your attention (line No. 14) to the relation between the number of meters and the population, expressed in percentage, which also shows the higher figures for the larger places. Combining all of the 384 places together, we have a population of 15,252,615 with an amount of gas sold of 26,982,608,967 feet, and an average sale of 1,770 feet per capita.

UNITED STATES AND CANADA.

	Under 20,000 Population.	20,000 to 100,000 Population.	Over 100,000 Population.
1. Number of places	230	130	24
2. Population	2,364,489	5,418,476	7,459,650
3. Average population	10,280	41,680	310,819
4. Gas sold	2,314,168,814	7,990,568,875	16,677,871,278
5. Number of consumers	102,101	323,353	621,276
6. Average number of consumers	444	2,487	25,886
7. Average price	1.47	1.42	1.10$^{4}/_{10}$
8. Total sold by meters	2,238,303,371	7,685,203,229	15,475,959,050
9. Average sold per meter	20,523	23,586	29,478
10. Average amount received per meter	32.77	32.29	32.13
11. Sales per capita feet; average by number of places	998	1,350	2,168
12. Sales per capita, dollars	1.58	1.80	2.42
13. Sales per capita by total quantity sold, and total population	978	1,474	2,237
14. Percentage of meters to populations	4$^{3}/_{10}$ %	6 %	8$^{3}/_{10}$ %

Since the completion of the above table two errors have been found which do not, however, materially affect the averages.

In the German "Gas Journal" of July 17, 1897, there appeared an article, by Mr. Emil Merz, of Cassel, Germany. In it are elaborate tables showing the consumption of gas in a number of cities in the years 1895-96. From these tables it appears that the average sale per capita in 77 German cities is 1,830 feet.

To recapitulate: The average of gas sold per capita, from the above tables, appears to be in—

The United States	1,770 feet
Germany	1,830 feet
England	4,245 feet

Regarding the application of Welsbach burners President Nettleton gave the following information:

In the matter of street lighting with incandescent gas burners some progress has been made in this country. I have been informed that the Welsbach Street Lighting Company, of America, have now in operation 2,700 lamps in 18 cities, and are rapidly increasing the number. In a recent issue of one of our gas journals the following statement was made: "The German Gas Association sent out inquiries in regard to the use of Welsbachs on the streets, and received replies that they were being used, to a greater or less extent, in 245 towns (presumably most of these towns are on the Continent) and in that number of places there were 61,569 Welsbach lamps in use out of a total of 287,721 public lamps.

NEW WEST INDIAN CABLE SERVICE.

A special dispatch from London of Nov. 4 says: To-day's issue of shares and debentures by the Direct West India Cable Company (limited) marks the beginning of the end of England's dependence upon the United States for cable connection with the West Indies. But for President Cleveland's Venezuelan war message England would probably have been quite content to continue to depend upon the United States lines, via Florida and Cuba, but directly the officials here realized the possibility of a war with the United States, and the consequent isolation of the West Indian colonies, they set about the negotiations which, after a long, hard fight with rival United States telegraph interests, resulted in an imperial subsidy of $40,000 yearly for twenty years to the British-Canadian capitalists who own the Halifax-Bermuda cable for its extension from Bermuda to Jamaica, and ultimately to other leading West Indian islands and South America. The cable will be completed by the first week of February next. As showing the spirit of the new enterprise, it may be said that of to-day's issue of $300,000 in shares and $600,000 in 4½ per cent. debentures, more than two-thirds were subscribed privately before the issue was offered to the public.

STATIONARY ELECTRIC MOTORS IN RAILROAD ECONOMY.

The Baltimore & Ohio Southwestern Railway has been experimenting with electric motors on turn-tables. Turning locomotives at divisional points and terminals is a service of much annoyance and no little expense to railroad companies. It generally takes four men to turn a locomotive and while they are doing so their regular work is abandoned.

Experiments were made with an electric motor on the 60-foot turn-table at Chillicothe with such success that the Park street turn-table in Cincinnati was similarly equipped. The result has been rather astonishing in the matter of expense. The current was purchased from the power plant and it cost on an average less than one-half a cent for each time the table was turned. When this same table was operated by hand it cost 12 cents for each engine. The yearly saving is about $709.

HALL EFFECT IN LIQUIDS.

The existence of a true Hall effect in liquids has for some time been the subject of controversy between French and Italian physicists. Bagard, on the one hand, claims to have proved its existence, while Roiti and Florio (Nuovo Cimento) attribute the effects observed to secondary actions. The latter now criticises Bagard's method from a theoretical point of view. He points out that, owing to electrolysis of the solution, its constitution is in an unstable state, and that the time elapsing between the various measurements of co-ordinates, according to Bagard's method, may give rise to differences of potential resembling a Hall effect. He also draws attention to the formation of metallic filaments and deposits, and shows that the Joule effect cannot be eliminated by choosing thick films of liquid, as the current density is left unaltered.

SECONDARY WAVE IN DIELECTRICS.

If an insulator is immersed in a dielectric traversed by electromagnetic waves from an oscillator, and has a dielectric constant different from that of the medium, it becomes the centre of secondary waves similar to those produced by resonance, with an important difference, however. The resonator gives out waves of a definite period and damping factor, depending upon its structure, whereas the insulator "responds" to all waves emitted by the oscillator. The secondary waves are easily demonstrated by shielding the resonator from all waves except those from the insulator. A. Righi has made a large number of experiments with spherical and cylindrical bodies of glass in various positions, and shown how to avoid the disturbances produced by such bodies in experiments on electric double refraction and other subjects.—Nuovo Cimento.

RATES OF DEPOLARIZATION.

Some additional light is shed on the above controversy by a paper by K. R. Klein (Wied. Ann.), who has investigated the rates of depolarization of mercury and platinum electrodes under various circumstances with the aid of a capillary electrometer. He employed electrodes differing in area as much as 300-fold, the small mercury electrodes being produced by dipping platinum wires into sodium amalgam and driving off the sodium by heat. At low temperatures these wires behaved just like pure mercury. A series of well defined results were obtained. The area of the electrode does not signify, but the rate of depolarization is considerably retarded by prolonged polarization and by cold. In most cases the depolarization would be retarded five or tenfold by cooling from 40 degs. to 1 deg. The electrolytes employed included various acids and alkaline salts, but the nature of the electrolyte is of slight influence, except in a special case. This case occurs when the electrolyte contains a small quantity of a salt having the electrode metal for a base and the same acid as the main electrolyte. When this happens the rate of depolarization is greatly increased. This fact is significant, and the author makes a good deal of it in support of Warburg's conduction-current theory of electrolysis, which assumes the formation of just such a salt.

THE SITUATION IN TERRE HAUTE, IND.

With regard to recent events at Terre Haute, already noted in The Engineer, the city council has passed unanimously resolutions asking the retention of Mr. Russell B. Harrison as president and Mr. M. F. Burke as manager and commending their work. The local "Gazette" puts its finger on the taxes and says, "the city taxes, county taxes and State taxes are all heavier than they ought to be," and adds that the Legislature frightened capitalists in the matter of street car bonds.

A NEW MERCURY INTERRUPTER.

This is described by F. Hofmeister, and has been invented by Schurr, of Tübingen. On the shaft of a small motor are mounted a copper disc and a three-rayed star of nickeline with platinum tips. The disc and the star dip into separate mercury troughs, and the terminals of the circuit to be interrupted also dip into these troughs. When one of the tips is dipping the current passes along the shaft and out by way of the copper disc. The disadvantages attending the use of a bearing as a contact are thus avoided. The number of interruptions may be varied from 5 to 60 per second. The mercury into which the star dips is covered with water. One filling of mercury lasts several weeks.—Wied. Ann.

COLD DIELECTRICS.

The abnormally high values obtained by Dewar and Fleming for the dielectric capacity of certain electrolytes at the temperature of liquid air do not agree with the formula proposed by R. Abegg for liquids, and the latter finds reason to criticise these results. The equality of the charging and discharging currents of the condenser containing the frozen dielectric is attributed by Abegg to the persistence of the electrolytic polarization after the polarizing current has been broken. This leads to a strong discharging current on completing the galvanometer circuit, which has been misinterpreted as implying a high dielectric capacity. Experiments carried out on hydrochloric acid with a slight addition of alcohol at 15 degs. and at —87 degs. show that polarization may remain constant to within 5 per cent. for a whole minute after break at the lower temperature, and that polarization goes on at a rate 100 times slower at the lower than at the higher temperature. This may be explained by considering that polarization has the essential characteristics of a process of diffusion, which is notoriously retarded by cold.—Wied. Ann., No. 10, 1897.

THE ZEEMANN EFFECT.

Walter König (Wiedemann's Ann.) has devised a differential method of observing the Zeemann phenomenon which gets rid of the difficulties due to the displacements consequent on the mere turning of the analyser. In the first place he uses the dark sodium absorption lines generated by passing light from an arc lamp through the magnetised flame. Then he places a quarter-wave plate with its axis at 45 degs. to the collimator slit over the latter, and observes through a telescope provided with a double refraction prism. The slit is shortened until the two images just touch each other. The beam passes through the perforated poles in the direction of the lines of force, and on exciting the magnet the two slit images appear displaced laterally with respect to each other, owing to the extinction of right-handed light in the one image, and left-handed light on the circularly-polarized edge of the other. The difference of wave length produced by a field of 7,300 units is 1-56th the distance between the D lines in both directions, giving a total broadening of 1-28th. For observations with the beam of light normal to the lines of force the quarter-wave plate is omitted, and as the doubly refracting prism is turned one of the dark lines becomes narrow, while the other is doubled. The light as a whole never appears polarized. The new method of observing is specially advantageous in obtaining photographs of the phenomenon.

THE SYNCHRONOME SYSTEM OF ELECTRICAL TIME-DISTRIBUTION.

An ingenious system of electrically-driven clocks has recently been developed by the Synchronome Syndicate, and is illustrated by a number of timepieces in the West End of London, most conspicious of which is the electrically-illuminated clock at Picadilly-circus. The method of time distribution consists in connecting all the clocks in series with a central controlling apparatus, which sends out over the circuit 120 impulses per hour. These impulses are all that is required to drive the mechanism of the clocks and each impulse actuates a positive feed motion in such a way as to move the minute hand through 3 degs., corresponding to 30 seconds of time. A reduction gear transmits the proper movement to the hour hand. The central controlling mechanism is a pendulum and gear, regulated to close the electrical circuit once in exactly every 30 seconds. It will be seen that by this system, which is the invention of Messrs. F. Hope-Jones and C. B. Bowell, no attention to the circuit clocks, and no self-winding or other similar apparatus are necessary.

PAY OF GOVERNMENT ELECTRICIANS.

A special dispatch from Washington of October 28 says: An increase of the pay of the men aboard naval vessels who are connected with the electric service is strongly recommended by the chief of the bureau of equipment in his annual report. He shows that the service is difficult, requires more expert knowledge and more continuous work than falls to the lot of other enlisted men, and figures are produced to illustrate the fact that the number of men on our ships assigned to this service is only about one-sixth of those employed in similar service on foreign naval vessels.

PERMANENT MACHINERY EXHIBITION IN PERU.

Consul General Bergmann, of Peru, has received word from his government that a permanent exposition of machinery, such as agricultural implements, mining machinery, electrical appliances of every description, and labor-saving machinery, will be opened at Lima on December 9. Mr. Bergmann has also been notified that all machinery sent to Lima by American exhibitors will be exempt from custom house duties and consular fees. Exhibitors are permitted to show their wares for a period of six months, and each exhibitor is allowed a space of 250 feet. The exposition is to be established by the Peruvian government for the purpose of increasing its trade with the manufacturing countries, especially with the United States.

EDUCATIONAL

METEOROLOGICAL STUDY AT THE UNIVERSITY.

A DISTINGUISHED meteorological authority sends us the following:

Our earth acts upon our steel magnets as though it was itself a great assemblage of magnets. It is penetrated by electric currents as though it was itself a part of a great dynamo. Our magnetic apparatus for the continuous record of the local magnetic variations alters its behaviour according as we move it from one position to another at the surface of the earth. The air, the clouds and the rain feel the influence of the electrified earth and are themselves electrified both by convection and induction. On the mountain peaks in the clouds and in the lower air, as well as in the highest upper atmosphere, everywhere we observe electric phenomena such as the lightning, the aurora, the earth currents and the innumerable irregularities in the differences of potential. Why are not these meteorological phenomena studied in our schools and universities? Of course the subject does not belong to elementary science, and to undergraduate courses of study, but needs attention from the higher classes of the colleges and scientific schools. The few who, having graduated in electrical engineering, or having gained the doctor's degree in science, find that they have a special ability to investigate in these broad fields of nature that lie beyond, should be encouraged and provided with the needed apparatus.

The electrical phenomena of the atmosphere are intimately bound up with its thermo-dynamic and hydro-dynamic phenomena, and constitute a large part of the whole subject of meteorology. What are our universities doing to help the present generation acquire a better knowledge of our atmosphere? We live in it and by it; all life depends upon it. The school children are taught elementary climatology and physiography, but one of the pressing needs of the day is that an adequate provision be made for the thorough study of the higher meteorology in all large universities. The auxiliary mechanics is frequently taught. The students are generally prepared for the work. The needs of the subject are recognized, but the chairs for the professors of meteorology are not yet endowed. The expenses are not provided for and the would-be students, the possible meteorologists of the future, are driven into other fields of work. The remedy for this unhappy condition is very simple. To whom should the friends of the higher education look for the necessary endowments if not to those whose life and property have been rendered more secure and even saved from destruction by the labors of the Weather Bureau? What that bureau accomplishes now is as nothing compared to what seems possible when we have fully mastered the laws of the motions of the atmosphere.

Shall not the Scientific School of Columbia University be provided with means to respond to this need of modern civilization?

THE B. & O. ROAD AS A COLLEGE.

A novel proposition was made not long ago to the receivers of the Baltimore & Ohio Railroad. The Baltimore & Ohio has a branch running from what is known as Alexandria Junction near Washington, to Shepard's, on the Potomac river, where a car ferry is operated in connection with the lines leading south from the Capitol. A professor of an Eastern college desired to lease this short stretch of track for the purpose of educating young men in practical railroad work. In his letter he explained that he thought there was a wide field for bright and energetic boys who could be thoroughly well grounded in the practical side of railroading provided they could be educated on a regular line of road. He believed that by the employment of veteran railroad men as teachers that the boys could profitably spend two or three years working as trainmen, firemen, engineers, switchmen, station agents, and in other capacities required in the railroad service. As this branch of the Baltimore & Ohio is of considerable value the receivers were compelled to decline the offer.

LEGAL NOTES

A RECEIVERSHIP FOR HAMILTON, O. DENIED.

Judge Neilan has dismissed the receivership case against Hamilton, Ohio. The Post-Glover Electric Company was denied a receiver. The demurrer was based largely on the fact that the petition did not state facts enough to constitute a cause of action; that there was no allegation in the petition that the city ever contracted this debt.

The city solicitor argued that no legal contract could be entered into unless duly authorized by resolution of council; that the petition did not state that it had been legally contracted.

Judge Crane had held that as the city had made two payments on the bill it was admitted to be legal, and that as the city had refused to pay its debts the creditor was entitled to a receiver as much as he would be for other corporation.

In passing upon the demurrer Judge Neilan said that there ought to have been a special demurrer to the petition, including other grounds as well as the general one, to have brought out matters more fully. He said that it was possible for the plaintiff to have been as much to blame as the defendant. When the goods were purchased the Post-Glover Company was presumed to know that the committee had no power to expend the money and the plaintiff was not in a good position to object.

The Judge further said that there was no authority whatever for filing the supplemental petition. There was no authority in any law for bringing suit for a receiver against a municipal corporation or for the appointment of a receiver. A municipal corporation is part of a State clothed with powers delegated by a State and vested with certain rights and obligations imposed upon it, but only such as vested by law. The law providing for the expenditure of money by council was so plain and clear that it could not be misunderstood. It could only be expended by a resolution being passed.

The Judge, in closing, said that it was only necessary to put honest men in council and have the law honestly carried out, and there would be no floating debt, nor would the credit of the city be a byword.

The general demurrer was sustained and the petition for a receiver dismissed.

STREET RAILWAY LITIGATIONS

An ordinance requiring proper and suitable fenders on the front of electric cars to prevent accident, and making it unlawful to operate them in the streets without such fenders, is held, in State ex. rel. Cape May, D. B. & S. P. R. R. Co., vs. Cape May (N. J.) 36 L. R. A. 653, to be a valid exercise of the power to regulate the use of the streets. In another case of the same name on page 656, an ordinance regulating the speed of such cars is sustained, while a third case of the same name, on page 657, sustains an ordinance requiring such cars to come to a full stop before crossing intersecting streets

The right of a street railway to run over a bridge built over a railroad at a highway crossing is sustained in Pennsylvania R. R. Co. vs. Greensburg, J. & P. St. R. R. Co. (Pa.) 36 L. R. A. 839. It is held that the railroad company is not an abutting owner that can contest such use of the bridge.

INVENTORS' RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOVEMBER 2, 1897.

Alarms and Signals:—

SIGNALING APPARATUS. P. G. Hubert, New York, 592,954. Filed June 4, 1897. Hotel call system.

ELECTRIC SIGNAL APPARATUS. F. W. Cole, Newton, Mass., 592,962. Filed March 10, 1896. Police telephone and signal system in which the telephones are placed out of circuit while a code signal is being transmitted.

Batteries, Primary:—

GALVANIC BATTERY. H. J. Brewer, New York, 592,760. Filed April 15, 1893. Employs a cover having a cup formed thereon, having a battery element passing into it, and supported therein, and an elastic connection interposed between the head of the cup and the element.

Batteries, Secondary:—

CHEMICAL ELECTRIC GENERATOR. H. K. Hess, Syracuse, N. Y., 592,782. Filed May 7, 1894. A secondary battery in which is embodied a conduit provided with a series of branch passages communicating with the inner chambers of inclosing supports, for discharging the active material therein.

ELECTRIC BATTERY. A. D. Wheeler, Hyde Park, Mass., 592,853. Filed Jan. 22, 1897. Embodies a cover consisting of two plates, having elongated openings extending inwardly from one end, and placed one upon the other with their openings extending in opposite ways.

Conductors, Conduits and Insulators:—

DISTRIBUTION BOARD FOR ELECTRIC CURRENTS. H. W. Shonnard, New York, 592,889. Filed Nov. 17, 1896. The main circuit bars are secured directly to the insulating slab foundation and the branch circuit bars are simultaneously connected to the slab by the same connecting devices.

INSULATING COUPLING. C. F. Hummel, Brooklyn, N. Y., 592,930. Filed March 22, 1897. Adapted for use in connection with gas pipes or fixtures.

Distribution:—

ELECTRICAL TRANSFORMER. Nikola Tesla, New York, N. Y., 593,138. Filed March 20, 1897. For description see page 452 this issue.

Dynamos and Motors:—

MAGNET ARMATURE. H. M. Paine, Amherst, Mass., 592,917. Filed April 20, 1897. Comprises an armature in separated parts with a lap joining the sections.

Electro-Therapeutics:—

APPARATUS FOR ELECTRICALLY TREATING DISEASES. H. E. Waite, New York, 592,844. Filed Aug. 11, 1897. Designed for treatment of diseases of the ear.

DENTAL ELECTRODE. F. L. Morhard, New York, 592,878. Filed March 1, 1897. Comprises a conductor having a pocket to hold the anesthetic and non-conducting shank adapted for contact with the opposite jaw or tooth.

Lamps and Appurtenances:—

CARBON HOLDER FOR ARC LAMPS. C. C. Bailey, Woonsocket, R. I., 593,172. Filed Feb. 26, 1897. A lower carbon holder adapted to receive carbons of different sizes.

REGULATING SOCKET FOR ELECTRIC LAMPS. C. A. Chute, East Liverpool, Ohio, 592,951. Filed June 14, 1897. Comprises a ventilated socket containing a rheostat of the separate spool pattern.

ELECTRIC LIGHT FIXTURE. F. B. Mason, Brooklyn, N. Y., 592,805. Filed March [illegible], 1895. Feed mechanism for arc lamps.

Miscellaneous:—

ELECTRIC DIAPHRAGM. N. Marchal, Dieuze, Germany, 592,802. Filed Jan. 13, 1896. Consists of a plate cut from limestone or equivalent integral natural alkaline-earth carbonate.

IGNITER FOR GAS ENGINES. F. C. Olin, Buffalo, N. Y., 592,881. Filed Dec. 7, 1896. Details of construction.

AUTOMATIC HEAT REGULATING SYSTEM. J. V. Stout, Easton, Pa., 592,924. Filed June 6, 1895. Details of construction.

ELECTROLYTIC APPARATUS. E. Motz, Brewer Mine, D. C., 592,973. Filed June 26, 1897. Comprises a trough, a series of curved communicating passages tapering from their inlet to their outlet ends and the opposing walls of each passage being formed by cathode and anode plates.

Railways and Appliances:—

ELECTRIC RAILWAY. R. M. Hunter, Philadelphia, Pa., 593,051. Filed Sept. 23, 1896. Comprises a conductor loosely supported within a slotted conduit upon transverse insulating supports, a traveling car, and a positively rotated current collecting contact.

ELECTRIC RAILWAY SYSTEM. H. P. Wellman, Ashland, Ky., 593,143. Filed May 26, 1897. A system for utilizing alternating electrical currents, single or multiphase by means of transformers whose magnetic circuits are completed by an inductor carried by the motor car.

CURRENT CONTROLLER FOR ELECTRIC RAILWAYS. F. A. Anderson, Washington, D. C., 593,154. Filed Oct. 12, 1897. Sub-trolley in which all the exposed working parts are insulated.

ELECTRIC CONDUCTOR AND CONNECTION AND SUPPORT THEREFOR. W. McElroy, Brooklyn, N. Y., 592,815. Filed April 30, 1892. Means for dropping a wire from its supports when its tension is loosened. Adapted for overhead trolley construction.

ELECTRIC RAILWAY SYSTEM. W. Robinson, Boston, Mass., 592,831. Filed Feb. 15, 1895. Sectional conduit system. Details of construction.

TROLLEY WIRE HANGER. N. J. St. Hilaire, Gardner, Mass., 592,923. Filed June 20, 1897. Details of construction.

TROLLEY FOR ELECTRIC CARS. E. C. Davis, New York, 592,928. Filed May 25, 1897. Comprises a trolley arm provided with a swiveled attachment, spring arms which project in the same direction as the trolley arm, and provided at their outer ends with a shaft on which a trolley wheel is mounted.

WIRE CLAMP. W. H. Brodie, Brooklyn, N. Y., 592,949. Filed May 8, 1896. Comprises two pivotally connected sections adapted to clamp the wire. Adapted for overhead trolley line construction.

ELECTRIC MOTOR FOR STREET CARS. C. E. Emery, Brooklyn, N. Y., 592,965. Filed Oct. 15, 1892. Comprises an electric motor frame in the general form of a cup, capable of being made fluid-tight, with the ends raised above the center to receive pole-pieces and with sides forming the field yokes cut down at the armature shaft bearings.

SINGLE RAIL RAILWAY CAR. F. W. Dunton, Hollis, N. Y., 592,866. Filed July 29, 1897. Comprises a traction wheel having an internal gear with an electric motor having a pinion that engages the wheel, a supporting frame and with a fifth wheel within which the traction wheel is centered.

Regulation:—

ALTERNATING CURRENT REGULATOR. D. O. Hull, Clyde, O., 593,050. Filed Oct. 17, 1895. Details of construction.

Switches, Cut-Outs, Etc:—

ELECTROMAGNETIC CIRCUIT BREAKER. D. C. Spruance, Philadelphia, Pa., and M. Waddell, New York, 593,167. Filed Jan. 25, 1897. Comprises a breakable bar forming a section of the circuit and a hammer adapted to strike and break the bar.

Telegraphs:—

TYPEWRITING TELEGRAPH. L. R. Hammond, New Haven, Conn., 593,095. Filed May 18, 1896. Details of construction.

Telephones:—

METHOD OF AND APPARATUS FOR RELAYING TELEPHONIC MESSAGES. A. W. Erdman, Milburn, N. J., 592,769. Filed July 6, 1897. For description see page 456, this issue.

MUNICIPAL AFFAIRS

SIOUX CITY, IA., TO CONTROL ITS STREET CARS.

Steps will be taken soon at Sioux City, Ia., looking toward municipal control of the local street railway lines. There are five different systems—the Sioux City Traction, Central Traction, Morningside Elevated, Leeds Electric and Riverside Park companies. Their officers recently applied for extensions of franchises varying from twenty-five to seventy years. Some of the citizens objected strenuously and, with some difficulty, induced the city council to refuse the grants. To the discussions held in connection with this matter is due, in great measure, the present movement for the purchase and operation of the lines by the municipality. Considerable money is invested in the different plants, but none is what can fairly be termed paying property. Leading business men think by consolidating them, managing all from a single office and supplying all from a single power plant the city could at least make them pay expenses—even at a less rate of transportation than that now charged. The present owners are making so little that they may sell, it is said, at a reasonable figure, since their hopes of franchise extensions and big future profits are cut off.

MARRIED

KELLOGG—PIERCE.

The marriage occurred on October 27 of Mr. James Warner Kellogg, of the General Electric Company, Schenectady, N. Y., to Miss Louise Cook Pierce, of New Bedford, Mass., daughter of Mr. Andrew G. Pierce, of the Wamsutta Mills. Mr. Kellogg is an honor graduate of Lehigh University, whose experience began in the engine works of the Allis Company, at Milwaukee. He entered the service of the Edison General Electric Co. as a draughting engineer. He has steadily risen until to-day he is in charge of that important branch of the General Electric Company's business devoted to marine and isolated plant work. He has had the supervision of the electrical equipment of almost all the vessels of the United States navy, and deservedly holds a high position in the esteem of his employers, comrades and business friends.

REPORTS OF COMPANIES

PHILADELPHIA LIGHT, HEAT AND POWER CO.

The above company, which includes the several electric lighting plants of Philadelphia, has just made its annual report. It says: "You will recall that at the end of the past fiscal year we had a surplus of $146,691.65. It is very gratifying to your management to be able to report that, after placing the properties of the company in first-class condition, throughout their various departments; and after paying out of our income the interest on the Edison 5 per cent. trust certificates and the dividends upon our preferred and common stock we still have a surplus of $151,892.11.

"During the year improvements and betterments have been made in the general operations of the several properties and in the management of the general business, by which we have increased the gross earnings of the business. We have decreased the operating expenses $37,505.24, and have increased the net profits of the business $49,309.45.

"We have expended for permanent plant and construction on the various properties $218,749.66. We have, of course, drawn upon the income and surplus accounts of the various properties for this expenditure.

"Our street system throughout the city covers a total of 677 miles of copper wire conductors, 318 miles of duct and 27 miles of conduits.

"We have connected each of the various systems of our properties with one another, so as to get the best economies under the most practical conditions. We expect to have this system in full operation during the month of November.

"Our boiler capacity is 12,564 h. p. Our engine capacity is 11,440 h. p.

"Our connected load to October 1 is 106,620 16-candle power incandescent lamps, an increase of 13,154 over last year. Our motive power is 3,321, an increase of 551 over last year. The number of arc lamps is 4,830, an increase of 748 over last year.

"In the new extensions which are now in progress and which will be completed during the present year we will have additional boiler capacity of 750 h. p. and additional engine capacity of 1,500 h. p., which will give us, with other improvements, an additional capacity of 20,000 16-candle power incandescent lamps.

"The directors of the company were re-elected, 150,000 shares being voted. The directorate comprises Martin Maloney, William L. Elkins, George Philler, W. W. Gibbs, George S. Graham, Thomas Dolan and John Lowber Welsh."

THE STOCK MARKET

A CUBAN WAR SCARE.

With all the conditions of betterment in active operation, the stock market had a chill and depression last week, due, it would seem, to a carefully worked up Cuban war scare. The recent result of the elections does not appear to have had anything to do with it, for it is notorious that local issues everywhere made their effect deeply felt in the voting, quite regardless of national politics. As to general conditions, the export trade remains very large, agricultural prices are high, railway earnings are steadily good, and the business failures in October were the smallest for years past.

Last week Western Union, on sales of 22,375 shares, went off to 85½, although the company is doing a good business and is improving the physical condition of its property, particularly with copper circuits out West. General Electric, on sales of 9,235 shares, went to 30⅛, although the company is loaded with work of all kinds from all over the world. American Bell Telephone was off to 255, or $30 per share less than two months ago, although the company's business has distinctly improved in the period.

Copper is quoted: Lake, 11 cents; electrolytic, 10¾; casting, 10⅝. Lead is 3.90 to 3.95 in New York. Steel rails are perhaps a shade weaker.

TRADE NOTES & NOVELTIES

WESTERN ELECTRIC CO. DOINGS.

The Western Electric Company have recently introduced a pneumatic carrier system connecting the sales department with the store rooms and order department.

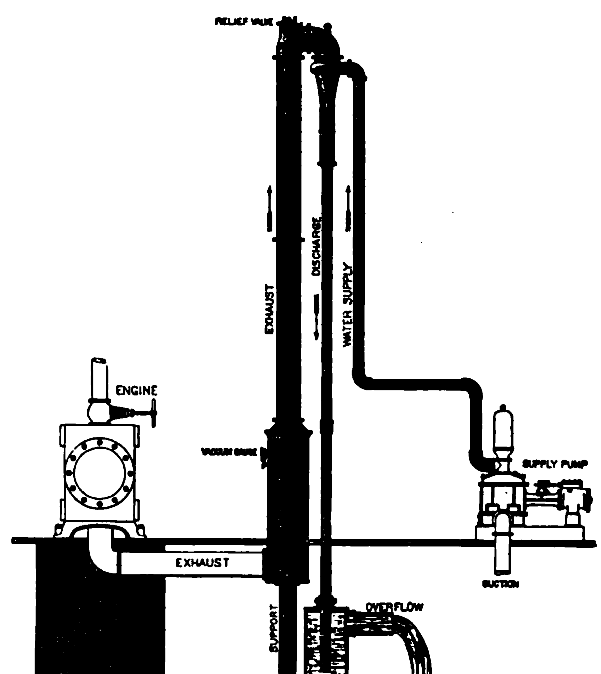
The company is mailing to its customers a very handsome picture of a lion which is a reproduction from nature. This picture is a half tone, printed upon a cardboard 11x14 inches, with a silk cord at the top for hanging.

The company has furnished a room 18x18 in the rear of its store as a show room for fixtures. Numerous chandeliers and brackets have been placed in this room and these have been wired up with 2-point, 3-point, 4-point and combination switches in order to show the methods by which lights in private houses may be controlled. A large variety of beautiful shades is shown on the fixtures. They also exhibit five of the Western Electric enclosed arc lamps.

THE BULKLEY INJECTOR CONDENSER.

Modern steam engineering practice is drifting more and more toward the use of independent condensers and air pumps, for reasons which past practice with direct connected apparatus has made sufficiently clear.

Among the independent condensers which have come into use the Bulkley "injector" has taken high rank on account of its efficiency, safety and durability, combined with simplicity. The Bulkley condenser is of the injector type, combined with syphonic water supply and discharge pipes. The condensing water entering at the side opening, passes downward around a conical exhaust nozzle in a thin circular film. The exhaust steam is thus condensed within a hollow cone of falling water, which by its velocity through the contracted neck of the condenser, expels the air and vapor into the discharge pipe below. The column in the discharge pipe being long enough to overcome the pressure of the atmosphere, the water is delivered



THE BULKLEY INJECTOR CONDENSER.

into the "hot-well" by gravity. A very high vacuum is thus maintained, and may be formed before the engine is started, or while it is standing. The Bulkley injector condenser will syphon the water from a head of ten feet or more after starting, or it can be supplied by a rotary, a centrifugal or other pump, driven from shafting, or a steam pump may be used.

The condenser illustrated in the accompanying engraving is connected with the exhaust pipe of the engine at a height of about 34 feet above the level of the hot-well, which should be

placed as low as it can be drained. A tight discharge pipe extends from the condenser nearly to the bottom of the hot-well, and is always sealed by the water in the same. The condenser being supplied by a pump (or from a pressure or head, where one is available), the action is continuous, the water discharging into the hot-well by gravity.

The area of the neck of the condenser is greater than that of the annular water inlet above, and the height of the water column overcomes the pressure of the atmosphere without. This construction makes it impossible for water to be forced or drawn over into the cylinder of the engine, no matter how the engine may be handled in starting or stopping.

As the supply pump delivers cold water only, it is therefore but one-third of the size of the air-pump required with other forms of condensers, which work hot water and vapor. The atmospheric pressure elevates the water about 26 feet to the condenser (after the vacuum forms), so it will be seen that the load on the supply pump is very much smaller than where air-pumps are employed.

The Bulkley injector condensers are now in use on simple and compound engines of 50 to 2,500 h. p. in many steam plants, including a large number of electric light and power stations throughout the country, and our readers may recall their use in the model plant of the Paterson, N. J., Edison Company. Mr. Henry W. Bulkley, the manufacturer, St. Paul Building, Broadway and Ann street, New York, has had an experience of over twenty years with his condenser and its constantly increasing use demonstrates its value, where economy in steam engine work is desired.

KEYSTONE SWITCHBOARD, POTENTIAL AND CURRENT INDICATORS.

THE Keystone Electrical Instrument Company, of Philadelphia, announces a new line of switchboard, potential and current indicators designed to meet the class of trade requiring accurate and durable instruments at low prices.

The cut shown herewith gives a general idea of the shape of the instrument and the character of the scale. The instruments are mounted in a tastefully designed case, finished in oxidized copper and well lacquered. The moving parts are

KEYSTONE POTENTIAL INDICATOR.

mounted in jeweled bearings, the cases are dust proof and the instruments are not affected by external magnetism or changes of temperature.

While the prices at which these instruments will be offered are very low, yet it is claimed that none of the essential features of a thoroughly reliable instrument have been in any way slighted.

THE SIEMENS JUBILEE.

This is a year of jubilees, and even the electrical profession is not left out. Messrs. Siemens and Halske on Tuesday, October 12, celebrated the fiftieth anniversary of the establishment of their firm at Berlin. The event has caused a very great amount of interest, and congratulations were presented at the celebration meeting by deputations from the Berlin. Charlottenburg, Vienna, St. Petersburg and London branches, and a number of presents were offered, including a portrait of Herr Werner Siemens, painted by Koner. Herr Carl Siemens read a deed establishing a fund of a million marks for the benefit of the workmen and officers of the firm, and providing for the appointment of a committee of officials to consider the best means of employing the money. Herr Wilhelm Siemens delivered a speech, dwelling upon the two guiding principles of the firm—scientific research and perfection of work. Congratulations were also presented by Herr Delbrueck, Minister of State, on behalf of the Association for the Promotion of Industry, and by Privy Councillor Herz on behalf of the Berlin mercantile community. Mr. Alexander Siemens attended these functions to represent the English firm of Siemens Bros. & Co.—London Electrical Engineer.

THE HARRINGTON DUPLEX CAR SIGN.

AN illustration is given herewith of the Harrington "Duplex" car sign, designed and built by Mr. W. E. Harrington, of Camden, N. J., for whom Mr. Elmer P. Morris, 15 Cortlandt street, N. Y., is agent. Street railway companies feel the importance of showing clearly, by night as well as day, the destination of their cars, especially where uniform cars are used over several different routes; and all manner of signs have been devised for such work. Until the "Duplex" was developed the majority of them embodied features rendering them impracticable, owing to the extra wiring required. The location of the sign is an important feature, as it must be accessible for quick and ready adjustment, in a place where the

HARRINGTON DUPLEX CAR SIGN.

car crew cannot help seeing it and its condition at all times. Placing the sign up on the car roof is said to be particularly bad, as the complications of mechanism are very annoying, and there is a great liability to get out of order. Some sixty different patents have been granted upon various intricate sign mechanisms, without the end sought being reached.

The Duplex sign is placed snugly under the board or projecting roof of the car, over the heads of the car crew, and directly accessible by them. The signs are interchangeable and can be moved from one car to the other if the conditions warrant it, such as bunching the traffic all on one line. The lamp placed upon the platform serves the double purpose of illuminating the signs and lighting up that part of the car. In the day time the lettering shows white on the dark background and is legible at long range. The signs have, moreover, the merit of being very low in cost, comparing favorably in this respect with any others on the market.

AMERICAN APPARATUS IN RUSSIA.

The Ball Engine Company, of Erie, Pa., are in receipt of the following letter from Julian Kennedy, the eminent steel works engineer, of Pittsburg, which refers to a 400 h. p. vertical engine direct connected to a Siemens-Halske generator: "I am in receipt of a letter from Mr. H. S. Loud, general manager of the Nicopol-Mariopol Mining and Metallurgical Co.'s works in South Russia, in which, among other things, he says: 'The electric plant is working beautifully. You would be doing an almost obligatory service in thanking both the Siemens-Halske and the Ball Engine people for me for the very great satisfaction which their machinery has given this company. The Ball Engine people were especially gracious in the prints, etc., sent, and their workmanship is magnificent.' I take pleasure in advising you of Mr. Loud's appreciation of your machinery."

PHILADELPHIA NOTES

"MINES AND MINERALS" is the new name of the "Colliery Engineer," one of the best papers in the technical field. With its new title a larger field of usefulness opens up, in which we are glad to wish our esteemed contemporary success of every kind.

NEW ENGLAND NOTES

THE LIVING AGE has so long maintained a conspicuous position in the current literature of the day that it requires only to be known to be valued. At this season, when the reading public are deciding upon their subscriptions to periodical literature for the ensuing year, we feel it incumbent upon us to call especial attention to this weekly magazine. There is no single work published which is so calculated to inform and entertain readers with the spirit of the age—critical, political and literary. In the issue of November 6 was given the first instalment of a new serial story: "With All Her Heart," translated for "The Living Age" from the French of M. Rene Bazin. To all new subscribers to "The Living Age" for 1898 will be sent gratis the eight numbers of 1897, containing the first instalments of "With All Her Heart."

THE COLLINS COMPANY, of Collinsville, Conn., in order to better their facilities, and to meet the demands of their increasing business, are making extensive improvements in their plant at Collinsville, and have placed the contract with the Berlin Iron Bridge Company, of East Berlin, Conn., for a large addition to their forge shop. The new construction will be entirely of iron in order to have it fireproof, no woodwork being used in the construction.

PROVIDENCE, R. I.—A hatter has had in his window several jack o'lanterns made of pumpkins and at night they are lighted with electric lamps. One of them is dressed to imitate the famous Yellow Kid, with the inscription: "I never was born, but, like Topsy, I just growed."

JEWELL BELTING COMPANY, of Hartford, Conn., have changed the name of the "Diamond" brand of belting to "Hartford." Quality, finish and workmanship remain the same.

BRYANT ELECTRIC CO., of Bridgeport, Conn., have issued a very handsome, complete and instructive catalogue of their sockets, switches and cut-outs. It is oblong, with 90 pages of text, each page handily and boldly numbered at the side margin, and all the devices are numbered, coded, illustrated and priced. Of switches, sockets, cut-outs, plugs, etc., a great and complete variety is shown.

SOUTH NORWALK, CONN.—The Electric Light Commissioners of South Norwalk will proceed at once to construct an incandescent electric lighting system of about 2,000 lamps capacity, 16 c. p., and are in the market for boilers, engines, dynamos, etc. Full information may be had on applying to Mr. A. E. Winchester, commissioner and consulting engineer, at South Norwalk.

BIBBER-WHITE COMPANY, 49 Federal street, Boston, have received an accession to their forces in the person of Mr. Herbert W. Smith, who has become manager of their railway department. Mr. Smith has issued a notice to the trade asking for their orders and support.

F. R. HARRIS, 35 Benedict street, Waterbury, Conn., has his factory busy on orders. Mr. Harris manufactures spring and electric wire; also fine brass, copper, German silver and phosphor bronze wire, and draws special alloy wire to order.

P. R. WAGOR & CO.'S catalogue A has been of benefit to many wishing to purchase wire guards for incandescent lamps. Their office and works at Springfield, Mass., are reported busy, both on their regular line and on special guards to order.

THE WALLACE BARNES ESTATE, Bristol, Conn., is booking large orders for springs among the electrical trade and outside, which has been keeping the factory very busy right along. The Wallace Barnes factory was established in 1857; it is probably the oldest and best equipped of its kind in the country. Every description of spring is manufactured. They enamel springs, also plate them. Ribbon steel is made on order and tempering done at short notice. They supply also flat or round wire, steel or brass and carry also a complete assortment of high grade cold rolled steel in stock from .003 to .049 in thickness. This concern invites samples of work required and will furnish quotations.

C. J. ROOT, Bristol, Conn., manufacturer of the Bristol counting machine, is placing his counters in many factories. For keeping accurate record of all work done on foot and power presses, weighing, measuring and automatic machines, this device pays for itself over and over again. Circulars and price list will cheerfully be mailed to any address on application.

THE J. & E. STEVENS CO., of Cromwell, Conn., manufacturers of toys of all descriptions, have decided to rebuild their foundry building recently burned The new buildings will be constructed as near fireproof as possible. The framework of the buildings will be steel, and the covering will be corrugated iron. The Berlin Iron Bridge Co., of East Berlin, Conn., have the contract for furnishing and erecting these buildings in accordance with their designs. The main foundry portion is 40 feet wide and about 200 feet long. Besides the foundry building proper there are two small brick buildings having a steel roof, one a boiler shop and the other a plating room. All the buildings are lined with Berlin patent lining.

NEW YORK NOTES.

MR. C. G. WINSLOW is installing a plant of 500 lights for the Rochester Electric Light and Power Co., with transmission of one and a half miles from water power to village.

W. B. OSTRANDER & CO., 22 Dey street, New York, have just issued their revised catalogue, being the eleventh edition. It includes, in generous detail, their famous speaking tube hardware, their electric bell goods, electric light material, telegraph and telephone goods and a big line of miscellaneous electrical supplies. It is remarkably complete and should be on file everywhere.

STANLEY & PATTERSON, 34 Frankfort street, are receiving a remarkably large number of orders for their new double magnet annunciator drop; also for their improved cases which are so made that the front may be removed from the wall without disconnecting bell or drop, saving much trouble, as in this way the annunciator may be tested out without an extra bell. There is not a spring of any kind in the entire mechanism. Their standard magneto bell which rings through 10,000 ohms resistance is another fast selling article of their manufacture.

MR. W. L. GREELEY has assumed the general managership of the Electrical Mercantile Agency and has removed the offices to 34 Park Row. The agency is thoroughly equipped to furnish complete reports on the standing of electrical concerns in all parts of the country.

COLUMBIAN STEAM BOILER CO., 526 Driggs avenue, Brooklyn, are very busy on orders for several 1,000 h. p. boilers for the New York Steam Company and others. They have been asked to bid on numerous contracts of late, and will be able to give out the details shortly.

STUCKY & HECK ELECTRICAL MANUFACTURING Co., of Newark, N. J., report doing a very heavy business on motor repair, work in connection with electric railroads. They do repairing, re-winding and reconstructing for every system—armatures, lighting dynamos, power generators, motors, transformers, etc.

A GENERAL ELECTRIC CO.'S electric motor will soon be in operation hauling freight among store houses and docks located on the river front at Hoboken, N. J.

FRED RECKENZANN, E. E., 44 Pine street, consulting and contracting electrical engineer, has been busy for the past few months on a number of contracts. His specialty is storage battery plants for lighting, power and signaling, equipments for launches, yachts, etc., controlling devices; also designing, examinations, tests and reports. Mr. Reckenzann solicits correspondence in regard to difficult work.

ECK DYNAMOS AND MOTORS are fast growing in demand throughout the trade. For neatness in design and smooth running they are in the front rank. Goldmark & Wallace, 29 Chambers street, New York, selling agents, are placing Eck dynamos and motors all over the country.

GENERAL INCANDESCENT ARC LIGHT CO. write us: "Owing to the unexpected increase in volume of the enclosed arc lamp business, and in view of greater convenience to our customers, we have decided to open a downtown office in New York, instead of handling business entirely from our factory as heretofore. We have accordingly established headquarters in room 602, Bowling Green Building, 11 Broadway, and have placed in charge Mr. Fred E. Dolbier as manager of the arc lamp sales department, to which office all orders and inquiries for arc lamps should be sent."

CHERRY ELECTRIC WORKS, 25 Third avenue, New York, are receiving large duplicate orders for their voltmeters and ammeters, so many in fact as to tax the capacity of their factory to the utmost. They report having received orders also, not only from this country, but abroad; while applications for agencies for their goods have come from Paris, London, Havana and other foreign cities.

MR. C. F. CROSELMIRE, the well known platinum refiner, whose product is familiar to the electrical trade, reports business as brisk, and states that he has closed a number of large contracts in the West, where his representative, Mr. Croselmire, Jr., has been traveling for the last three or four weeks.

WESTERN NOTES

PERU ELECTRIC MANUFACTURING CO., Peru, Ind., report their works busy. Their porcelain insulation and Laclede and Hercules batteries are selling heavily, not only in the United States, but are finding a large market in foreign countries. Peru Electric Manufacturing Co.'s catalogue will give the prospective buyer a good idea of the large line manufactured. They also solicit special designs of insulation to order in large lots.

K. McLENNAN & CO., sole manufacturers of the celebrated "Gale's Commutator Compound," which will absolutely prevent sparking and cutting of commutators and not gum the brushes but will put a high gloss on the commutator, stated to a representative of this paper recently "that the sales of their compound had increased more than three-fold since September 1; that at the present time their compound was regularly used by every power plant and central station in the United States and Canada and by a vast number of isolated plants. They stated further that the reduction in price of their compound to 50 cents per stick and $5 per dozen had helped to increase the sales. They have recently established agencies in Norway, Sweden, England, France and Germany and have in course of completion an agency in Japan. "Nearly all of this foreign business," stated Mr. Isaacs, manager of the company, "is due to advertising." They invite the readers of The Electrical Engineer who have not yet tried their compound to ask their supply house for a free sample stick or to write to them at their office, Marquette building, Chicago.

WARREN, OHIO.—The new Warren Electric Lamp and Machinery Co. have secured a factory location and will begin work on January 1. The company includes C. C. McNutt, Jr., Z. F. Craver, and A. H. Kreither, all of Warren, and Mr. I. Ackerly.

WALKER COMPANY have recently issued neat bulletins relative to their car motors for all classes of service and one giving the decision of the court in the Athol & Orange case, wherein an action brought on two patents, of Blackwell and of Rice, was dismissed by Judge Putnam. These patents related to the use of a U-shaped frame and gearing in attaching the railway motor to the axle of the car.

MR. HUGO DIEMER, heretofore purchasing agent for the Bullock Electric Manufacturing Co., and Mr. C. R. Hebble, of Xenia, Ohio, have gone into business as electrical contractors at Cincinnati, Ohio. The partnership will be known by the name of Diemer & Hebble, with headquarters at 810 Neave building. They will represent in their territory the Card Electric Company, of Mansfield, Ohio, and the Shelby incandescent lamp. As both gentlemen named are graduates from technical institutions, and have had practical, as well as live business experience, they hope to secure a fair share of the business in their territory.

SOUTHERN NOTES

RICHMOND, VA.—The Virginia Electric Co., of Baltimore, the Southern Electric Co. and the Home Electric Co., of Richmond, have all been applying to the city for franchises to use the waste flow of the James river for power transmission purposes.

ADVERTISERS' HINTS

THE HART & HEGEMAN MANUFACTURING CO., Hartford, Conn., suggest that both time and money may be saved by keeping on hand a supply of their gang plates and switches.

THE C & C ELECTRIC CO., of New York, will be glad to demonstrate the efficiency and economy of their 250-volt direct current system of supplying power and arc and incandescent lights in small towns.

THE AMERICAN RHEOSTAT CO., Milwaukee, Wis., ask "what's the use of paying more for motor starters of other makes that do not operate as satisfactorily as ours?"

THE AMERICAN ELECTRIC METER CO., Ninth street and Montgomery avenue, Philadelphia, is now prepared to take orders for early delivery of all sizes of three-wire constant potential registering meters.

THE ANCHOR ELECTRIC CO., 71 Federal street, Boston, Mass., say: "The merits of the Anchor flush type of switch are obvious and compel us to emphasize them as giving desirability to that form."

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. NOVEMBER 18, 1897. No. 498.

ELECTRIC POWER AND LIGHTING PLANT OF THE MERGENTHALER LINOTYPE CO., BROOKLYN, N. Y.

IT cannot have escaped the attention of the readers of The Electrical Engineer that the appearance of its pages has shown a vast improvement over their aspect up to about one and a half years ago. At that time The Engineer decided to adopt machine composition of its letter press in place of the time-honored hand composition handed down from the good old days of Guttenberg. The result has been that instead of being compelled to employ type which has been used over and over again, The Engineer appears every week in a new dress of type, with its clean-cut and sharp outlines. The machine on which the type setting is done is the Mergenthaler linotype machine, before which an operator sits and manipulates a lettered keyboard. When he has, so to speak, played off a line on the keyboard he throws a lever, and while he goes on setting the next line, the machine automatically performs a number of operations which result in producing a finished line of type, perfectly "justified" to the exact width of the column, and ready to be locked up in the forms to go to press.

It would take us too far to go into the details of the truly wonderful performance of the linotype machine, but it may well be imagined that a machine, which sets the type, justifies it to the column width, casts the line, and redistributes the type matrices is a mechanical achievement of no mean order. The manufacture of such a machine requires the highest order of mechanical skill, and this the Mergenthaler Linotype Company have recognized from the very start. Their factory, in Ryerson street, near Flushing avenue, Brooklyn, N. Y., is one of the most complete of its kind, covering approximately 100,000 square feet of floor space, and its management, which is in the hands of Mr. W. H. Randall, is a model of its kind.

FIG. 2.—ENGINE AND DYNAMO ROOM, MERGENTHALER LINOTYPE CO., BROOKLYN, N. Y.

Mr. Randall, by the way, was formerly prominently identified with the factory management of an electrical manufacturing company, and hence it is not strange that, seeking to bring the Mergenthaler works up to the highest notch of economical operation he should have considered the advisability of doing away with the antiquated belt drive and substituting electric power. With this end in view, Mr. Randall brought the matter to the attention of Mr. Philip T. Dodge, president and general manager of the Mergenthaler Linotype Co., and after due consideration it was decided to make the change.

In order that our readers may get some idea of the conditions involved in the change from belt to electric countershaft driving we present in Fig. 1 a cross-sectional view of the Mergenthaler factory. The latter consists of several buildings, including a boiler house. All except the last named build-

ing have five stories and basement, all except one being of fire-proof or slow burning construction. As will be seen in Fig. 1, the factory previous to its electrical equipment, was run by a slow speed engine belted to a jackshaft overhead. From the jackshaft a belt was led to the right, connected with the main shaft on the third floor, and from this floor vertical belts connected to the shafting on the floors above and below. All these vertical belts were carried in a shaft built on the outside of the building wall, as shown. The building on the left hand side of the engine room was run by a horizontal belt connected to the main shaft on the second floor, with belts to the shafting on the floors above and below. There were thus in constant operation no less than twenty-four belts, ranging in width all the way from 12 to 24 inches, and any one familiar with the power consumed in belts will be able to form some idea of the amount of energy wasted in this arrangement.

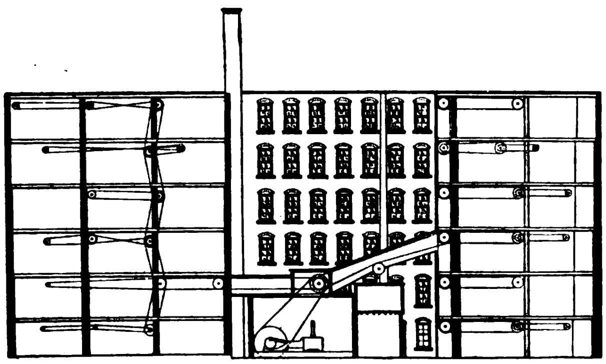


FIG. 1.—SECTION OF BUILDING SHOWING BELT DRIVING.

The company having decided to change over to electric driving, and at the same time to light its works by electricity, placed the entire matter in the charge of Mr. E. R. Knowles, E. E., as consulting engineer, and the details of the work as described below were carried out according to the plans and specifications of Mr. Knowles.

ENGINES, BOILERS AND DYNAMOS.

In bringing about the change it was decided to start afresh and to abandon entirely the old steam plant. In its place there have been installed two Ideal horizontal, high speed tandem compound, non-condensing engines, furnished by Messrs. W. R. Fleming & Co. The engines are run at 250 revolutions per minute, with steam at 140 pounds pressure, and are capable of developing 150 h. p. each.

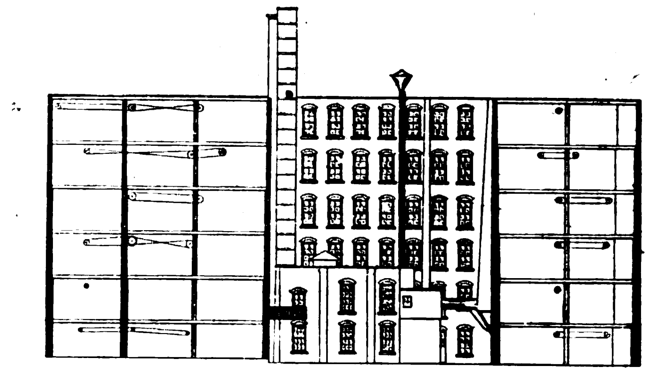


FIG. 6.—SECTION OF BUILDING SHOWING MOTOR DRIVING.

Connected direct to the engine shafts are two Walker generators of 100 k. w. capacity, running at 115 volts. The engraving, Fig. 2, gives a view of the engine room, showing the switchboard and one generator unit. The engine room itself is floored with asphalt, with a wainscoting of white enameled brick, the rest of the walls and the ceiling being finished in white, giving to the whole a most pleasing and ornamental appearance and making it in fact a model room of its kind.

In addition to abandoning their old engine, it was also decided to erect a new boiler plant and with that end in view there have been installed two new Sterling boilers, one of 100 h. p. and one of 200 h. p., together with an Excelsior feed water heater and separator. The boiler room is illustrated in Fig. 3.

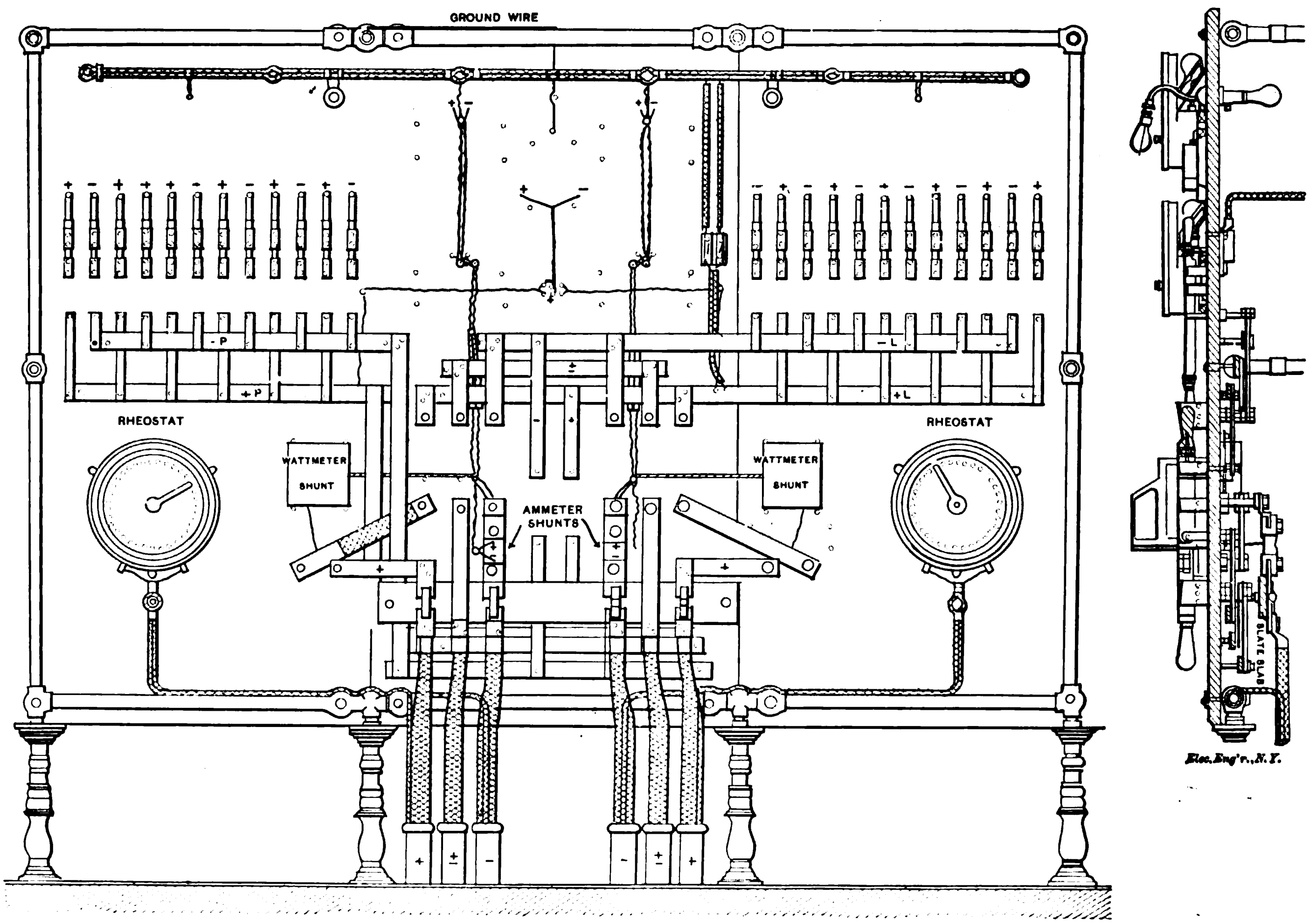


FIG. 4.—POWER AND LIGHTING SWITCHBOARD, MERGENTHALER LINOTYPE CO. REAR AND SIDE VIEW.

THE SWITCHBOARD.

The object being to afford both light and power from the same generators, either singly or together, required a special design of switchboard, which has been carried out in a very neat and simple manner. The engraving, Fig. 2, shows the front of the switchboard, which is of marbleized slate, 1¼ inches thick, mounted on an iron pipe frame and supported on

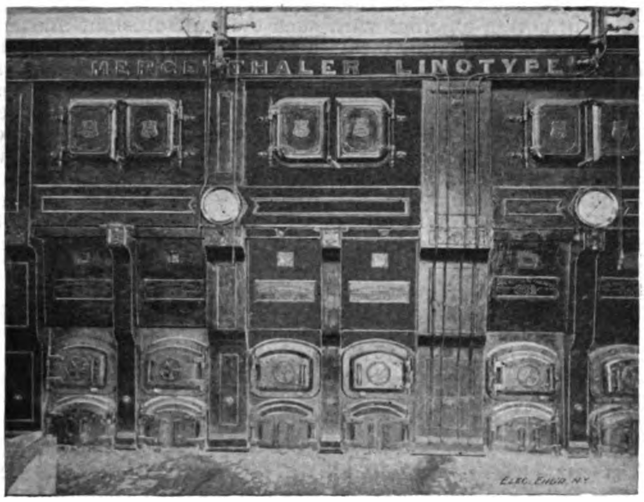


FIG. 3.—THE BOILER ROOM.

polished brass legs. This brings the board about 18 inches clear of the floor and about 30 inches out from the wall, to which it is securely fastened. It may be mentioned here that the brass legs have screw tops similar to a jackscrew, so that the board is given a firm footing at every point of support. Mounted on the front of the switchboard, in the centre panel, are two Weston round pattern ammeters for the dynamo feeders, and two Weston voltmeters. Between the four instruments just mentioned is placed a Weston ground detector, graduated to give the insulation resistance between either side of the system and earth.

Below the indicating instruments are mounted two double-pole, double-throw knife switches for the dynamo feeders, and between these, a double-pole single-throw switch for emergency connection of the bus-bars.

The panel at the right holds the switches controlling the

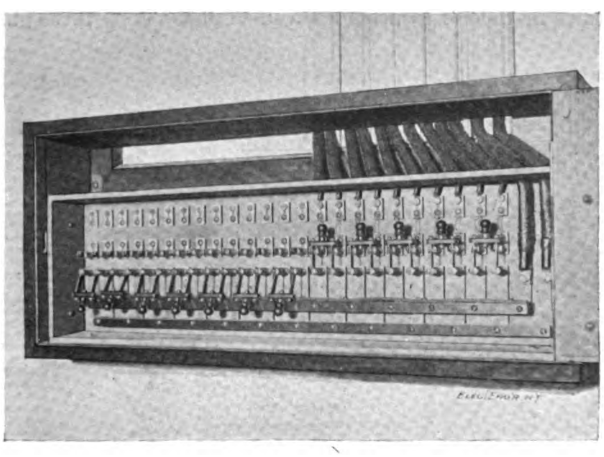


FIG. 5.—A CUT-OUT RECEPTACLE.

power circuits, while that at the left, the lighting circuits to the various floors of the building. All these switches are of the Hill type. It will also be noticed that each of the side panels has mounted on it a General Electric wattmeter, which registers the amount of power consumed by the two classes of circuits. Pilot lamps at the top serve to illuminate the board.

While the front of the board claims attention by reason of its beauty, the back is even more interesting on account of its simplicity of arrangement and ease of access to all the connections and bus-bars. The diagram, Fig. 4, illustrates the layout so plainly that little description is required. This view shows the framing of pipe on which the panels of the board are mounted. A distinguishing feature of the construction is the use of straight bus-bars and connections throughout, as shown in the side view in Fig. 4. These bars are supported on bolts of differing length so as to leave ample clearance between them, and thus all bending of bars has been avoided. The generator connections, it will be observed, are led to the board from below, and the mains take a right angle bend to the wall and are led straight up to the various floors to the cutout boxes, the box controlling the basement floor being placed directly behind the switchboard. Dynamo regulation is effected by two Carpenter enameled rheostats with the hand wheels at the front of the board.

The switchboard, which is a model of its kind, was built according to the designs of Mr. Knowles, by Messrs. Blake & Williams, of New York.

THE WIRING SYSTEM.

The wiring system is designed for feeding current to about 1,600 16 c. p. lamps and also for seven 5 h. p. motors and

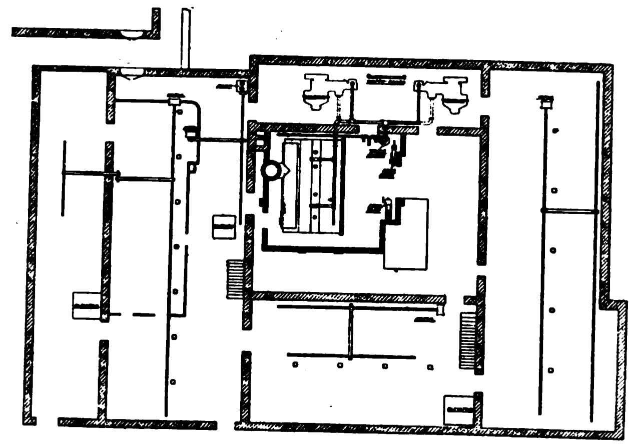


FIG. 7.—PLAN OF BASEMENT.

eight 10 h. p. motors. The wiring is installed on the two-to two system. The conductors have been so calculated that at full load of lights and motors the loss between switchboard and the farthest lamp or motor shall not exceed 5 per cent., as computed on the two-wire system. In addition the system is so designed that an additional 10 per cent. in lamps may be added in the future should they become necessary.

The wiring system throughout the buildings is enclosed in standard grooved molding provided with a cover, painted with insulating paint on the inside, and painted white outside.

The main and branch cutout boxes, one of which is shown in the engraving, Fig. 5, have porcelain cutout blocks, and Bergmann knife switches and fuses. The whole is enclosed in an oak receptacle provided with a door and lock. The electric light wiring system and the motor wiring system, it should be added, are independent of each other throughout the buildings, except at the switchboard. Rubber covered wire

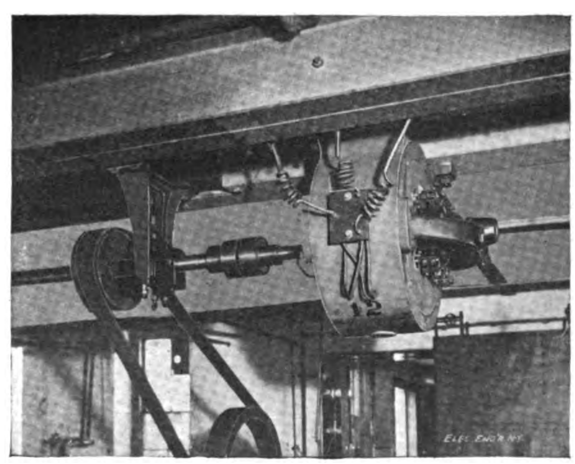


FIG 8.—MOTOR DRIVING MACHINERY IN BASEMENT.

has been used throughout and the entire wiring system was installed by the Tucker Electric Co., of New York.

THE MOTORS.

Having to deal with a plant already fully equipped and in operation and it being imperative that none of the machinery should be stopped for a single instant, it was considered inad-

visable to apply electric motors directly to the machines and tools. The plan adopted, therefore, was to place motors directly at the ends of the main shafts driving the machinery or the various floors. Our engraving, Fig. 6, shows a sectional view of the buildings as at present arranged, and this view has been placed in juxtaposition to Fig. 1, illustrating the old belted plant.

The general plan of the layout of the basement is shown in Fig. 7 and this arrangement is followed as closely as possible on the other floors. The following is a list of the motors and

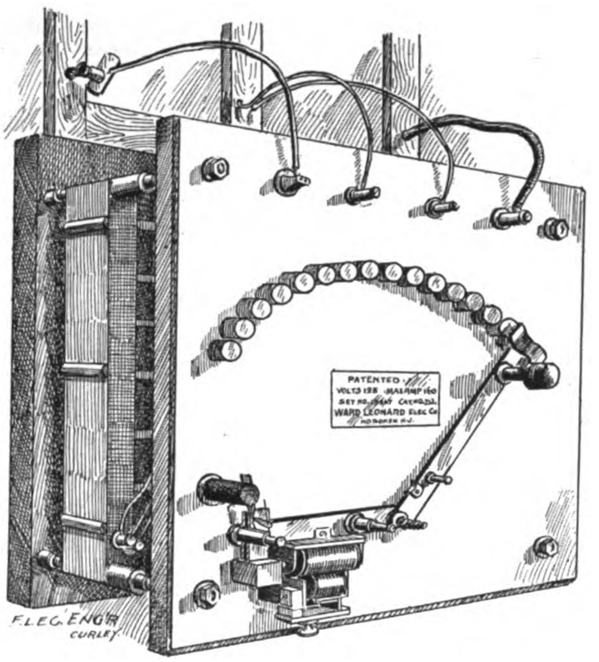


FIG. 9.—LEONARD AUTOMATIC MOTOR RHEOSTAT.

their location, there being fifteen in all, furnished by the Bullock Manufacturing Company:

	Factory A.	Factory B 2.	Factory D
Basement	Two 5 h. p.	Two 10 h. p.	
First floor	One 10 h. p.	One 5 h. p.	
Second floor ...	One 10 h. p.	Two 10 h. p.	
Third floor	One 5 h. p.	One 10 h. p.	
Fourth floor	One 5 h. p.	One 5 h. p.	One 5 h. p.
Fifth floor	One 10 h. p.	One 10 h. p.	One 10 h. p.

This makes a total of seventeen motors, aggregating 110 h. p.

Our engraving, Fig. 8, shows the manner of connecting the motors to the shafting. Each motor is hung from the ceiling

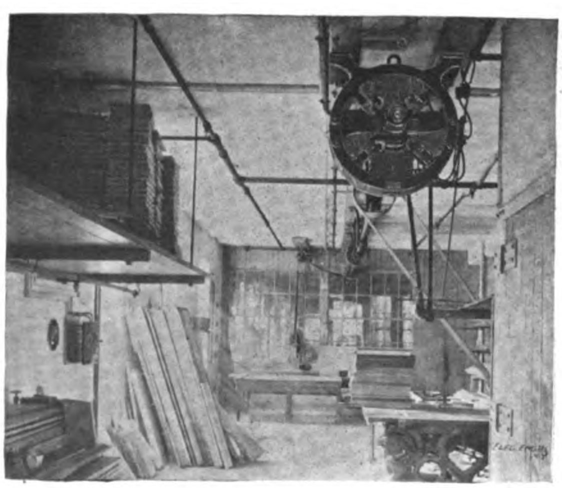


FIG. 10.—MOTOR DRIVING CARPENTER SHOP.

and connected to its shaft by a flexible coupling. This coupling is so constructed that a delignment of the main driving shaft does not interfere with the smoothness of operation. A Leonard starting box serves to control each motor and guards automatically against the closing of the switch except when the entire resistance of the rheostat is in circuit. It also automatically opens the switch when the voltage of the supply fails, and also when the current through the motor becomes excessive. Fig. 9 illustrates one of the universal automatic starting boxes connected with the 10 h. p. motors, built and installed by the Ward Leonard Electric Co. for this plant.

The elevator running from the basement to the top floor is also operated by an electric motor. Fig. 10 shows the motor driving the machinery of the carpenter shop.

A plant gotten together with such evident foresight and embodying the latest and most improved apparatus which the art afforded could not but result in marked economies in more ways than one, especially in a workshop where the highest order of skill is required to produce the manufactured product. The Mergenthaler Linotype Company are fully convinced of the wisdom of the step they have taken and they deserve credit for having afforded their consulting engineer such wide latitude in the carrying out of the plans. It is claimed direct connected slow speed motors, and the results so far obtained are certainly to the credit of Mr. E. R. Knowles, their consulting engineer, who has made a specialty of electric power applications.

As to the economy of the plant it may be stated that although the plant has been in operation but a short time, enough data is at hand to show that it is effecting a decided saving over the cost of running the old plant, notwithstanding the fact that it is furnishing power and light, whereas the old plant furnished power alone.

TESTING THREE-PHASE INDUCTION MOTORS—TRANSFORMER CONNECTIONS—FULL LOAD CURRENTS—FAULTS AND HOW LOCATED.—II.

(Concluded.)

BY W. T. MORRISON.

THE second case in the single-phase method is with a delta connected motor. Fig. 3 represents the three-phases connected delta, the cross on a phase representing a reversal of the phase or of a coil in that phase. Impedances taken on 1 and 3, 1 and 2, 2 and 3 show the first to have the highest current and therefore to be the defective phase. The high leg on a delta connected motor is the defective phase.

Another method of testing for a reversal is by direct current and a compass. First, with the current on 1 and 3; second, on 1 and 2, and lastly on 2 and 3, for either delta or Y motors. The number of poles should be easily distinguished and the polarity of the poles also. Any reversals will obliterate one or more poles.

A third method of locating a reversed phase is by three-phase

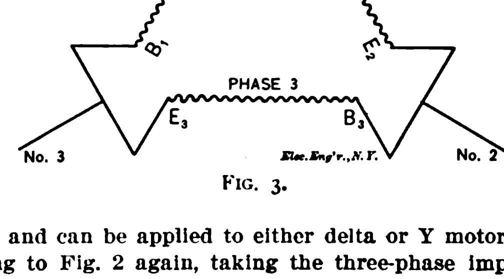


FIG. 3.

testing, and can be applied to either delta or Y motors. First, referring to Fig. 2 again, taking the three-phase impedances we obtain a high leg on 1. The high leg gives the end of the defective phase. The defective phase is the one not included between the low leg, that is, between 2 and 3, in this case.

The third method as applied to a delta motor is apparent from Fig. 3. Let phase 1 be reversed, three-phase impedances being taken; legs 1 and 3 are high and leg 2 low. The defective phase is always between the high legs.

A reversed coil will cause humming and a vibration, but will not affect the speed or the apparent ability of the motor to

carry its load unless there should be very few coils per phase.

The phase in which a reversed coil exists can be located by methods one and three, and also by method two modified to suit the circumstances. The proceeding is exactly the same as in testing for a reversed phase. A short circuited turn in a coil will give the humming, but will not unbalance the current or voltage to any appreciable extent. It will not burn out under full load. Neither can it be found by measuring the resistance of the field, as measured from the motor terminals. It can, however, be burned out and thus located.

To do this, a special transformer having only a few turns, from 5 to 10, is necessary. The armature is removed and this transformer put in its place. Such transformers induce from 10 to 20 volts per turn in the field winding and will burn out a short circuited turn in from 5 to 30 seconds. The transformer has to be moved, as it only covers a few coils at a time.

LOCATING FAULTS IN THE ARMATURE.

We present in the accompanying table the results of some of General Electric Company's tests on a 5 h. p. motor, which shows the effects on currents in the field of having one or more open circuits in the armature. The table, though not comprehensive enough to be final in all cases, will at the same time aid materially in testing out faults in armatures. The same motor was used throughout, the connections being changed to Y after all the delta readings were taken. The first reading gives the excitation current of a delta motor connected in Y, as shown in Fig. 2 ,which is the reason the current is so low. This is apparent when we compare it with the normal current of the motor in practice as connected in delta. This ratio of approximately 3.1 or of 1.36 to 3.95, as given in the table, would show at once if a mistake should be made, in connecting up the field, making a delta instead of a Y, or vice versa.

The second line shows that opening a coil in the armature materially increases the current running free. At the same time it is evident, from case three, that this does not follow from the first, for here it has a marked diminishing effect.

It is probably clear to the reader that the impedance readings as given in lines 4, 5 and 6 of the table, are merely the currents in the field, at full voltage, with the armature of the motor blocked. In this instance, as in the third, the opening of the second coil diminishes the current.

Commencing with the delta readings we have the normal excitation of a 5 h. p. motor of 220 volts. Contrary to the effect in a Y motor, opening a coil here diminishes the current, while the second coil increases it to 6.8.

The normal impedance, not given in the table, should be 21 amperes, with all resistance in the armature, and 42 when cut out. The first delta impedance reading shows only one leg near this when one coil is open. The next reading is similar in this respect. It is also noticeable that the greater unbalancing occurs in the delta motor where it also unbalances the voltage at the motor terminals.

Readings.	Volts. 1-3	1-2	2-3			Amperes. 1	2	3	Speed.	No. coils open.	Con-nected.	Remarks.
										.0	Y	
Excitation ...	220	220	220			1.36	1.36	1.37	1200	0	Y	
" ...	"	"	"			7.00	7.00	7.00	612	1	Y	
" ...	"	"	"			2.20	2.20	2.20	603	2	Y	With starting resistance all in, motor does not start. Starts only at certain points in the resistance out.
Impedance ..	"	"	"	Resis.		6.6	4.2	2.7	0	1	Y	
" ...	"	"	"	"	out	15.5	10.0	7.	0	1	Y	
" ...	"	"	"	"	in	1.25	1.25	1.24	0	2	Y	
" ...	"	"	"	"	out	7.	1.76	8.30	0	2	Y	
Excitation ...	220	220	220			3.95	3.95	3.95	1200	0	Δ	
" ..	"	"	"			2.90	2.90	2.90	623	1	Δ	With starting Res. all in, motor comes up to 600 Rev.
" ...	"	"	"			6.80	6.80	6.70	606	1	Δ	Starts with Res. out at certain points.
Impedance ..	220	216	216			6.2	19.	13.2	0	2	Δ	Resistance in.
" ...	220	214	216			4.1	48.	18.0	0	1	Δ	" out.
" ...	220	220	220			3.85	3.85	3.85	0	2	Δ	" in.
" ...	220	218	214			28.00	33.00	6.3	0	2	Δ	" out.

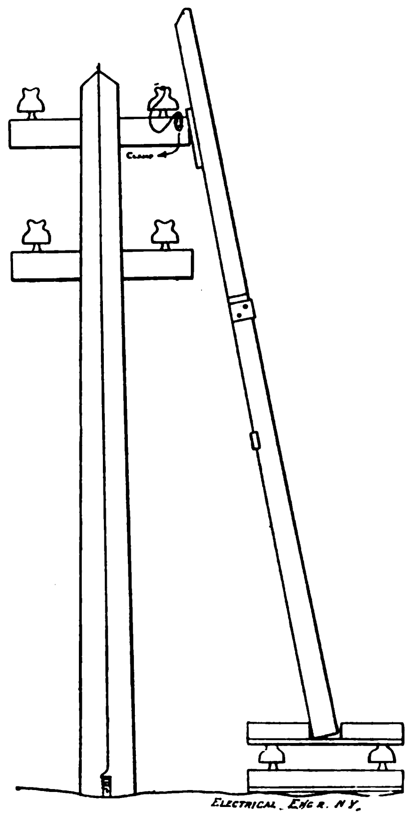
For the position of volts and amperes see Figs. 2 and 3.

Test of General Electric Three-Phase Motor.—60 cycles, 220 volts, 5 h. p.

MAKING CHANGES ON A LIVE 10,000 VOLT CIRCUIT.

WE illustrate herewith the method employed by Mr. W. B. Jackson, of the Peninsular Light and Power Co., Michigan, in replacing insulators on high voltage circuits, with current on the line. Mr. Jackson's circuits carry 10,000 volts alternating. He says in a recent letter to the J. G. White Company on this subject:

"The method I use in changing the insulators upon the 10,000 volt circuit is extremely simple, but at the same time quite safe, if due precautions are taken to have the apparatus dry.



ARRANGEMENT FOR REPAIRING LIVE HIGH TENSION WIRES.

We use a thirty-foot ladder in two parts so it can be made of the proper length to catch the cross-arm. At the upper end a small board is put on, having a hole in it of the right size to fit on the end of the cross-arm. For the ladder to stand upon we have a platform 30x30 inches square, having a lower part which has a pin with insulator at each corner, and an upper part which fits upon the insulators in the lower part. This upper part has two recesses for the feet of the ladder to fit in. When the ladder is in place some one goes up and screws a small hand-vise upon the cross-arm. The hand-vise is of iron and has a piece of copper wire soldered to it. This wire is touched to the line wire upon which the broken insulator is located, and if everything shows all right, is wrapped around same. A three-foot stick boiled in paraffine is used in first touching the wires together. When the grounding wire

is properly on the man goes to work with bare hands and changes the insulators; then the grounding wire is taken off and the clamp removed.

"With a plant such as we have it is an absolute necessity to be able to change the insulators at any time. The only time we can shut down without causing our customers trouble is between 3 and 4 p. m. on Sundays, and a bad insulator cannot be left from Monday till Sunday; at least should not. We have not found it necessary to take the voltage off any portion of the system for two months and fourteen days."

MISCELLANEOUS

DEVICES FOR SUPPORTING LARGE CONDUCTORS.—II.

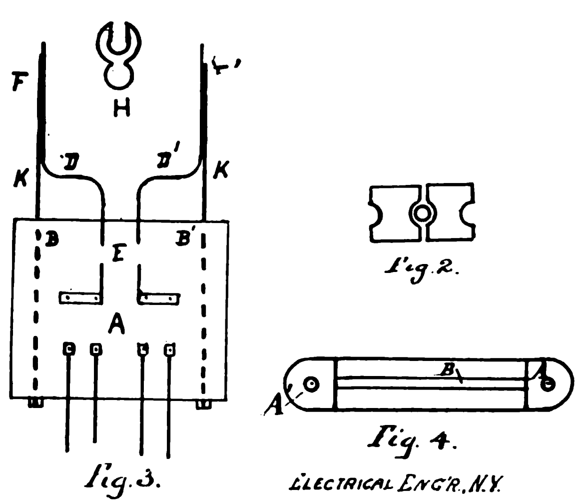
(Concluded.)

BY S. H. SHARPSTEEN.

THERE are many places where wire of very large carrying capacity is strung for long distances in conduits or subways, the latter having been constructed for the reception of water and steam pipes. This is common with the N. Y. State hospitals, where all the large buildings are connected in this way.

In the past many methods of running electric lighting mains have been tried, and in some cases the work has not proved very satisfactory. Fastening heavy porcelain into the brickwork by means of expansion bolts and laying the wires on or fastening them to this porcelain seems to be a good plan and is giving good results. In many cases wooden strips have been fastened to the brickwork and to these strips the insulators fastened by means of lag-bolts; the bad thing about this arrangement is the wood, which will soon rot and will have to be replaced. The conduits are often full of moisture from escaping steam; water is also present during wet seasons. In some cases the wire has been run between porcelain insulators, as in Fig. 2, the insulators being fastened to wooden strips.

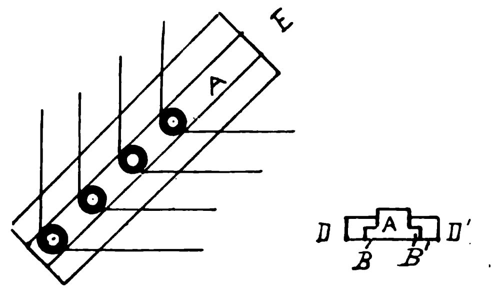
One thing that is annoying in this kind of work is the trouble in holding the wires tight when once in place. The wires are drawn up tightly, and the fastenings put in place; but when the jack or tackle, that was used to pull the slack out of the wires, is taken off, the wires sag back and are festooned. Possibly nothing is more aggravating than to work hard with a gang of men for hours to get a large wire drawn up and then have the annoyance of seeing it sag between supports when the tackle is taken off. The following device will dispense with such trouble and will enable the wires to be drawn up until they are as rigid as iron and held, if the supports are properly put up.



FIGS. 2, 3 AND 4.

In Fig. 3 we will assume that D and D' are two long, heavy wires that have come through a stretch of subway and have reached a place in the basement of a building where the entrance switch is to be placed and the branch wires commenced. A represents a piece of slate 14 inches long, 12 inches wide and 2 inches thick; B and B' represent two holes in the slate three-fourths of an inch in diameter.

The wires D and D' are drawn up tightly with a tackle block and at F and F' clips H are soldered onto the conductors D and D'. These clips should be about six inches long and cast of soft brass and have a projection, cast solid, in which a three-quarter-inch hole can be bored for a five-eighths-inch bolt. The slot in the brass casting should be just large enough to take the conductor. When the conductor is placed in the slot the thin edges of the slot should be drawn down tightly on the wire and well sweated on which torch and solder.



FIGS. 5 AND 6.

The slate board A is placed on the floor joists or side wall, as circumstances dictate; the rods K and K' are then passed through the hole B and B' in the slate and fastened into the clips on the wires at F and F'. With the nuts on the opposite edges of the slate from the clips the wires can be drawn hard and the tackle blocks relieved and taken down. It is readily understood that if the slab of slate A is properly fastened up the wires cannot sag; these wires can be drawn up at any time.

The wireman who has never had experience in this kind of work will be surprised to see how the supports will be pulled down if not well put up. If a wire with an inch conductor is well strung it will stand an enormous amount of pulling without being disturbed.

If the wires could be run perfectly straight in such places it would make the work much easier; but often the heavy wires will have to cross from one side of the subway to the other because of some obstruction, and then skill is required to do good work. When two knobs are used, as in the illustration, they will open, when the wire is pulled up, unless they be tied together with a strip of iron on top. This is a necessary precaution where any turn is made to keep the wire either from drawing down between the porcelain onto the wood or iron under the porcelain or from flying out from between the porcelain pieces. When the lengths of wire are not too great the better kind of porcelain is that with a hole in the middle with two holes for lag bolts. When these are strung over the wire and well fastened up, the wire draws through them nicely; they can be made in halves so as to clamp on the wire and be held together by the bolts that hold them up, but when the strain comes in the right direction the wire will try hard to drag into the division or the place where the two pieces of porcelain come together.

Where only one or two wires are strung, the porcelain would be best fastened directly to the mason work, but where a number of wires are to be put in one subway an iron receptacle for the porcelain should be put up and the porcelain fastened to this support; this will dispense with putting a great number of holes into the mason work for expansion bolts.

Fig. 4 shows how a simple casting of iron can be made to take the porcelain. A and A' are holes for expansion bolts to hold the casting onto the masonry; B is a slot in which to catch the bolt heads for holding the porcelain. The portion of the casting that is to take the bolts for the porcelain should be offset so as to enable the bolts to be put in place after the casting is bolted up.

When holes have got to be drilled into the masonry a certain distance apart so as to take two bolts for one piece of porcelain or casting, a jig should be used. When one expansion bolt is fast, hold the jig with it to enable the second hole to be drilled in the proper place. One of the best drills for this kind of work is made by taking a piece of round tool steel the size of the hole wanted, and by means of the milling machine or a hammer and chisel, cut four V-shaped places which will leave the cutting end like a cross; such a tool is easily sharpened and by the four edges it is prevented from running sidewise in a soft brick, or a seam between bricks like a cold chisel point will answer the same purpose.

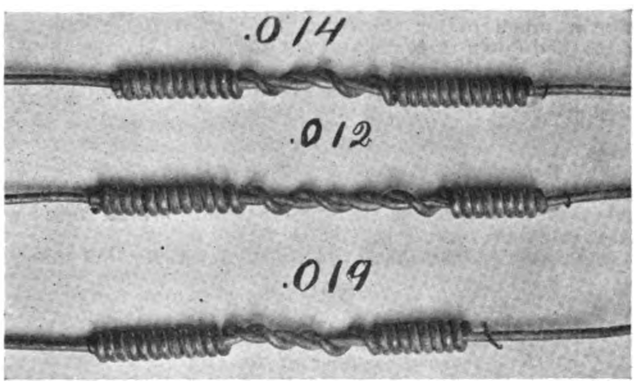
Many times the wireman gets a job of stringing a number of

large wires under a floor from a switchboard to a subway. or from one subway through a building to another subway. With such work it is often difficult to get the wires as tight as is wanted; the floor joist of a building makes a good place for fastening the porcelain supports, and by means of the device illustrated in Fig. 5 the wires can be drawn tightly. A represents a piece of strong timber acting as a corner piece on which to put the porcelain for a turn in the circuits; it is to be held in place by the strips B and guides D. While the wires are being strung and pulled up in the usual way the piece A with the porcelain should be in a position such that the wire will not make a right angle, but one more obtuse; and later, when the wires are pulled up and well fastened, a jack can be put behind the piece A and E and forced ahead until the wires are like fiddle strings; after the wires are sufficiently tightened the piece A can be blocked and the jack taken down. If there are a number of large wires to be drawn up the pieces D and D' will have to be well mortised into a number of the floor joists and securely fastened.

TO SOLDER OR NOT TO SOLDER.

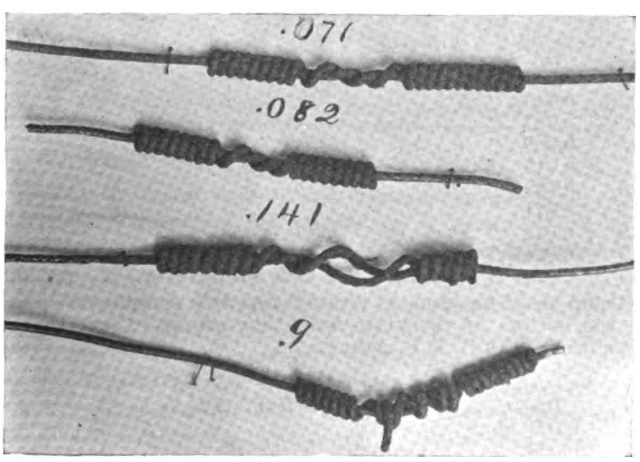
BY A. E. DOBBS and CHAS. H. NORTH.

WHETHER to solder or not to solder connections is a much mooted question among men engaged in telegraph and telephone line construction. Of course all will agree that a well soldered joint is an ideal one, but whether the extra time and work necessary to solder is justifiable in ordinary



Group 1.—Nos. 1, 2 and 3.

work is one about which construction men and engineers will disagree, we fear, for a long time to come. One man will pick up a disreputable looking joint that he has found somewhere, which is bad enough to cut out even a telephone, thus indicating a resistance of at least 25,000 ohms, and exhibit that

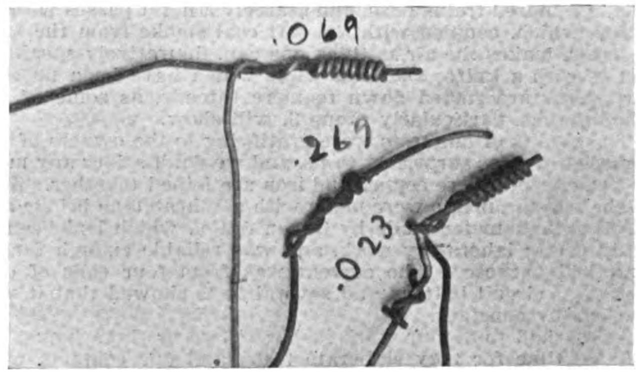


Group 3.—Nos. 1, 2, 3 and 6.

as a sample of what is liable to happen, while his opponent will argue that if men cannot be trusted to make good connections without solder, neither can they be depended upon to solder properly, and that lines soldered and unsoldered running side by side show no material difference in resistance.

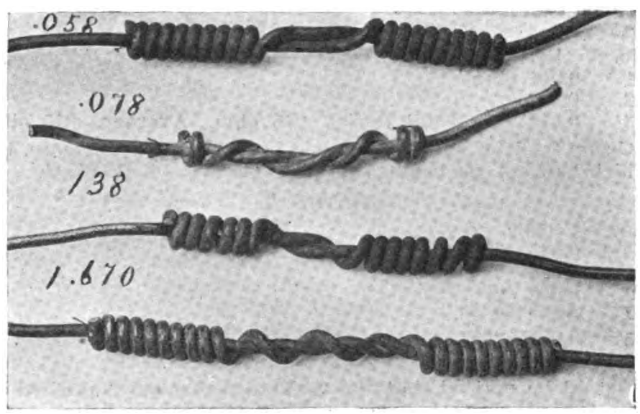
In this connection it may be remarked that we are personally aware of two lines built from New York to Boston in 1888 of No. 10 copper, which showed only a trifling resistance beyond the theoretical amount, although 100 miles of it was not soldered at all.

But this measurement was taken while the lines were still



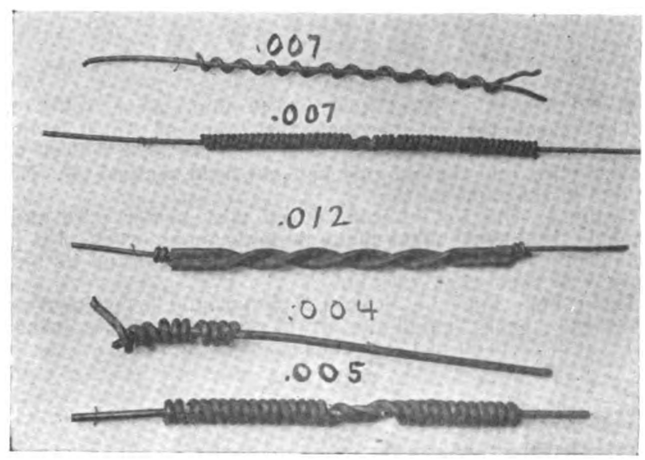
Group 5.—Nos. 1, 2 and 3.

new, and it is possible that later measurements would show a slight increase, for it is reasonable to suppose that a telegraph current, being continuously in the same direction will in time cause a slight oxide film due to electrolysis to gather at the points of resistance between two wire ends. But telephonic



Group 7.—Nos. 1, 2, 3 and 4.

currents are alternating or intermittent in character, and infinitesimal in quantity, to say nothing of the fact that the line is dead except when in actual use, so that increase in resistance cannot be expected from that source. Besides, the current raised by an induction coil, at the ratio of about 500



Nos. 1, 3 and 8 of Group 9 and Nos. 1 and 4 of Group 10.

to 1, possesses a voltage sufficient to overcome a considerable resistance and make a few ohms of no consequence.

Recently it occurred to the authors that while we had measured lines and cables many and many a time, we had never made any measurements of line joints themselves, and in rebuilding a small plant in an Ohio town we soon collected a

lot of specimens of all kinds, such as would be found in a plant which had been to a certain extent neglected, and which on account of the trying conditions surrounding the maintenance of overhead lines was of especial interest.

The town is a railroad centre through which, on a busy day, a hundred trains pass, and scarcely a night passes without a fog, which, coupled with the soft coal smoke from the locomotives, makes the air so thick one can, figuratively speaking, cut it with a knife; and iron wires which have been up only two years are rusted down to mere threads, as some of the photographs, particularly group 3, will show.

The results of our tests were gratifying to the owners of the plant, as well as surprising to us, and we don't solder any more joints, except where copper and iron are joined together.

The measurements were made with a Wheatstone bridge and 4-coil galvanometer made by Queen & Co., which had been in daily use in laboratory work, and was reliable enough for all practical purposes. The current was from four cells of carbon open circuit battery and several tests showed that it was reasonably constant.

As we had to do our work inside of two or three hours, we had no time for very elaborate tests, and our contacts were merely clasps, such as will be found on stocking or sleeve supporters, and several tests showed their constant to be about 0.01 of an ohm, which was deducted from all our measurements.

The number of samples tested was 50, which, for convenience, we have divided into groups. The sizes given are B. W. G. for iron and B. & S. gauge for copper.

Group 1.—Three samples of No. 14 iron wire (new), which were made up for this occasion, and are intended as examples of good line joints.

GROUP 1.

No.	Resis.	Remarks.
1	0.014 ohm	
2	0.012 "	
3	0.019 "	Total Resis., .045 ohm. Average, .015 ohm.

Group 2.—Iron wires which had been up a year or more, but which had not yet begun to rust. Size. No. 14, B. W. G.

GROUP. 2.

No.	Resis.	Remarks.
1	0.025 ohm	
2	0.025 "	
3	0.046 "	
4	0.050 "	
5	0.052 "	
6	0.062 "	Very poor. Total, .260. Average, .043 ohm.

It will be noticed that the resistance of even No. 6, which was very poorly made, was less than one-eighth of an ohm.

Group 3.—Old No. 14 wire, which had become so bad that it had to be taken down. It must be remembered that this wire has had to contend with fog, and the worst kind of soft coal smoke.

GROUP 3.

No.	Resis.	Remarks.
1	0.071 ohm	
2	0.082 "	
3	0.141 "	
4	0.150 "	
5	0.376 "	
6	0.9 "	
7	1.32 "	Total Resis., 3.040 ohm. Aver., 0.434 ohm.

The reason for the increased resistance of No. 6 is to be found in the fact that an old rusty piece has been spliced with newer wire, and the old rust had not been scraped off. No. 7 is due to the same cause.

Group 4.—Old No. 14 iron spliced with newer wire and is such as troublemen often make in doing repair work. No. 5 of this group was another rusty wire, not cleaned, and its resistance was somewhat variable.

Rusty ends must be cleaned if you would keep down your resistance, even though the strain on the line does insure a contact of from 50 to 150 pounds.

GROUP 4.

No.	Resis.	Remarks.
1	0.020 ohm.	
2	0.028 "	
3	0.023 "	
4	0.058 "	
	21.129	
5	21.0 "	Average Resis. for the first four, .032 ohm.

Group 5.—No. 14 wire, some quite rusty, and some not. The worst looking specimens we could find were selected for this test. Nos. 1 and 3 of this group were half connections, such as would be made to a common return, or a bridged circuit. No. 2 is simply one end of a tie wire which was cut off the glass and put in as a matter of curiosity.

GROUP 5.

No.	Resis.	Remarks.
1	0.069 ohm	
2	0.269 "	
3	0.023 "	
4	90.0 "	Total R., 90.361 ohms; av. for the 1st 3, .121.

Group 6.—No. 12 steel wire, which had been exposed to the air for a year or more, and put together without cleaning.

GROUP 6.

No.	Resis.	Remarks.
1	0.098 ohm	
2	0.652 "	
3	1.088 "	Total R., 1.838 ohms. Average R., .613 ohm.

Group 7.—No. 9 steel wire. These connections are all made in guy wires and are merely intended as pole supports, but nevertheless they form an interesting and at first sight a puzzling study. Why should a No. 9 wire, with its larger area and firmer contact, show a higher resistance than some of those miserable specimens of No. 14? It is possible that the stiffness of this wire prevents its "cinching down," as firmly as the smaller size? Yet again, why should No. 4 of this group, which is certainly well made, show the highest resistance of the lot, even though it was covered with a certain amount of dust and soot? This same peculiarity is also noticed in regard to group 6, which was made up of No. 12.

Of course we can say that the wire was dirty and not properly cleaned, but then those in group 4 must have been made under similar conditions, yet with one exception the former make a much better showing. We tried these again and again; filed down the ends and put additional clamps on to our contact pieces, but with no material difference. Following up this idea, perhaps, our telegraphic friends who use large wires are right in insisting upon solder.

GROUP 7.

No.	Resis.	Remarks.
1	0.058 ohm	
2	0.078 "	No. 4 is a new joint in old (but not rusty) wire
3	0.138 "	
4	1.670 "	Total R., 1.944 ohms. Aver. R., .486 ohm.

GROUP 8.

No.	Resis.	Remarks.
1	0.013 ohm.	No. 18 copper to No. 14 iron.
2	0.032 "	No. 14 copper to No. 14 iron, 24 turns.
3	0.084 "	No. 14 cop. to No. 14 iron, 28 tns., b'ly r'sted.
4	2.610 "	No. 14 cop.. No. 14 iron, very badly rusted.
		Total R., 2.739 ohms. Aver. R., .685 ohm.

Group 9.—Hard drawn copper. On account of its greater smoothness, copper seems to make a better contact than iron and it does not seem to deteriorate much upon exposure to the weather. The line splices shown in this group are known among workers as "3-wire," "tie," or "double" splices. Nos. 1 and 2 of this group are soft ties, which were cut off the glass and shown as a matter of curiosity.

GROUP 9.

No.	Resis.	Remarks.
1	0.007 ohm.	Copper tie.
2	0.016 "	" "
3	0.007 "	Line connections.
4	0.008 "	No. 14 copper.
5	0.015 "	
6	0.029 "	
7	0.011 "	
8	0.012 "	
9	0.204 "	
10	0.020 "	Total R., .329 ohm. Aver., R., .033 ohm.

Group 10.—The same as group 9 and two samples are shown on the bottom of the plate with that group, except that the sizes are No. 10 B. & S. gauge.

GROUP 10.

No.	Resis.	Remarks.
1	0.005 ohm	
2	0.008 "	Ordinary telegraph splice.
3	0.010 "	Half connection, 12 turns.
4	0.004 "	Half connection, 9 turns.
		Total R., .027 ohm. Average, .007 ohm.

Conclusion.—The average line in exchange work will not contain over 10 connections after leaving the cable box, and 10 such connections as are shown in group 1 would only increase the line resistance 0.150 of an ohm, and even the badly rusted and hard-looking samples in groups 3 and 5 would (leaving out No. 4, in group 5.) only increase it about 4 ohms; while a line long enough for 100 such connections, equal to at least 35 miles,

would only be about 34 ohms, an amount which will surely not interfere with telephone work.

But it must be remembered that the average resistance of these joints is much too high, that we picked out some of the worst samples we could find and that many of them would not pass in construction work that is half way decent; while new wire and the tension on the lines would reduce this resistance about to the standard set by group 1. But a little calculation will show that the total resistance of the 32 samples, including the two bad ones in groups 4 and 5, is 118.6 ohms, and if the two bad ones are taken out it only becomes 7.6 ohms, which in 10 or 12 miles of wire would not be objectionable.

In our copper wires the three-wire connections showed up remarkably well, considering that they had been exposed to the weather and coal smoke for two years or more. They are undoubtedly the best form of joint for copper wires. We were surprised at the comparatively high resistance shown by the McIntyre joint, for we supposed its larger area of contact would reduce its resistance, but then we must consider that in this form of joint we have two connections; first, from the wire to the tube and from the tube to the other wire. Still, we think that the measurement of a large number of these joints would show better results, for we have frequently cut open old joints in which the hard drawn copper had moulded itself into the softer copper of the tubes, making a perfect fit, while the protection from the weather makes them very desirable. If, however, one can trust his men to make good connections, one will find the "3-wire" kind considerably cheaper. One kind of joint we always solder when practicable is where iron and copper are joined together.

In making joints in No. 12 or No. 14 iron wire, make a long twist and ten turns each side of the twist. In the larger sizes 5 or 6 turns each side of the twist is sufficient. In making copper connections the samples in groups 9 and 10 are good ones to go by. In making the "3-wire" connection the two ends are drawn past each other as in the ordinary splice and another wire about a foot long is spliced in with both ends.

If one studies the pictures here shown one need have no trouble with joints. If, however, one chooses to solder joints do not dip them, as that makes a wire brittle, and is apt to break it, or at least rust it out at the end of the twist, always the weakest place; but, instead, use a heavy iron, or a blow torch, and solder in the centre and be sure that the solder takes hold and makes a perfect union, for solder merely laid on is worse than useless.

Copper wires can be soldered the same way, and we have always found that a heavy iron was best for this purpose. Heat quickly and solder only in the centre and one will not lose anything from the copper softening, as the turns each side of the central twist will hold the wire. A man who knows how to solder copper will never break a wire, while a bungler will break half of them. But then if one will employ cheap or incompetent men one must expect trouble. One trouble that a great many of the newer exchanges have is that their managers entertain the idea that any farm hand can do exchange work and let their older rivals coax their best men away from them.

ROENTGEN RAYS

PHOTOGRAPHS WITHOUT LIGHT.

In a recent paper read by Dr. Russell before the Royal Society he described the results of a series of experiments which, to photographers, almost rival the discovery of the X-rays. From time to time various experimenters have claimed to obtain photographs by the long exposure of bodies to sensitive photographic surfaces without the action of light. With the exception of Becquerel's and Colson's experiments, the precautions taken for the exclusion of extraneous light have not been such as to place these experiments above suspicion. There now seems little room for doubt that many of the common substances with which we are surrounded have the property of emitting invisible active radiations, which can pass through many bodies that we have been in the habit of regarding as opaque. Becquerel some time ago showed that different compounds of uranium, if allowed to remain on a sensitive photographic plate for some days in the dark, had considerable action on the film, and if the plate was developed in the usual way a photograph of the body was obtained.

Dr. Russell, in repeating Becquerel's experiments, has discovered that this particular action is by no means confined to uranium salts, but that many of the metals and other bodies, such as wood, charcoal, copal, straw, etc., possess it in a marked degree. The radiations from these bodies, however, differ in one very important particular from those given out by the uranium compounds. While the latter readily pass through glass, the former are completely stopped by it. Mr. Colson, in January last, described the action of zinc, cadmium and magnesium on photographic films in the dark. At the time of making his experiments Dr. Russell was not aware of this, and consequently his results are independently confirmed.

Starting with the metals, mercury, zinc, magnesium, cadmium, nickel, aluminum, pewter, fusible metal, lead, bismuth, tin, cobalt and antimony, he found that all these, after a week's exposure near a sensitive plate in the dark, produced a distinct effect upon the plate, while gold, iron and copper only showed a very slight effect. The action is not in any way due to "contact phenomena," as a polished surface of zinc with a design scratched on it gave a distinct image of the markings when not touching the plate, and even when thin screens of gutta percha or celluloid were interposed between the sensitive plate and the zinc surface. Some metals were then coated with copal varnish to see if this would interfere with the effect. It was found that the image was more rather than less distinct.

In another set of experiments cardboard pill boxes were used for inclosing certain substances before allowing them to act upon the photographic plate. It was discovered that an empty box emitted active radiations, giving a most distinct image. This suggested experiments with different cardboards, when it was found that the better qualities were quite inactive, while the common varieties, known as straw board, had considerable action on the plates. Among the other bodies experimented with were green and dry woods, both of which were active. A section from a young larch tree gave an excellent image, showing rings and layer of bark. Charcoal was also found to be active, but lost its activity if heated for several hours in a closed crucible.

The results obtained with printers' ink were very interesting. In many cases they produced no action at all, and in other cases they were remarkably active. The ink used by the Westminster "Gazette," the "Standard" and the "Daily Graphic" gave excellent pictures of the printing. The "Times" showed not quite such good results, while ink of the "Morning Post" and the "Echo" had no action at all.

What is this mysterious force? Its nature has still to be discovered. Two points seem to have been established. The first is that an increase of the temperature of the body greatly increases its activity; the second, that aqueous vapor in no way assists the action. Bodies which at 0 deg. C. had no action whatever at 70 degs. C. gave distinct images. It has further been suggested that the chemical action is caused by a finely attenuated vapor given out by the different metals and other bodies. It is far more likely to be due to some hidden form of energy more or less akin to what has been paradoxically but suggestively called dark light.

MARRIED

WHITMORE—MARCELLUS-BUTTRICK.

Mr. Walter G. Whitmore, of the General Electric Company, and Miss K. Marcellus-Buttrick, of Bay Ridge, N. Y., were married Oct. 12 at the home of the bride's parents. Mr. Whitmore is a graduate of the Mass. Institute of Technology, whence he went to Chicago and was for some time with the Chicago Edison Company. In 1889 he joined the engineering staff of the Edison General Electric Co., and after the consolidation of the interests which became the General Electric Company, was placed in charge of the entire electrical construction work of the New York office of that company, with the title of Local Engineer.

Mr. and Mrs. Whitmore carry with them the best wishes of ourselves and of all his many friends in the electrical fraternity.

MR. GEORGE R. ALBERS, of the Bradley Polytechnic Institute, Peoria, Ill., in affiliation with the University of Chicago, says: "I have many times expressed my strong friendship for your paper, both in Chicago and out West. My copy here goes to the Institute reading room, where it is eagerly read by many of our students."

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UNIFORMITY IN INCANDESCENT LAMPS.

AT the meeting of the National Electric Light Association, a year ago last May, quite an animated discussion arose on the question of uniformity in lamp bases and sockets. If we remember rightly, a committee was appointed to investigate and report upon the matter, but, so far as we are aware, nothing further has been heard of the matter before the association. Nevertheless, the question is still an open one, and in view of the actual pecuniary interests attached to the matter, aside from the question of convenience, it seems strange that it has been allowed to drift along as it has. The desirability of having a uniform type of sockets and bases for incandescent lamps can no longer be a subject for argument. Manufacturers of incandescent lamps would hail a standard lamp base with joy and users of lamps would be benefitted by it in more than one way. But while uniformity in lamp bases is eminently desirable, one cannot help thinking that uniformity in other details of incandescent lamps would be equally so. We are led to this conclusion by a glance at a recent list of the isolated plants in New York City, giving the voltage and candle power of each individual plant. In these plants, numbering over 500, the varieties of details in lamps called for in those plants are simply startling. The result of such a state of affairs must be apparent. The lamp manufacturer who wants to be able to supply every order which may come to him must of necessity carry in stock, or be prepared to deliver at short notice, all these various types and conditions of lamps. The result is that he is put to large expense and necessarily this expense is in the end borne by the lamp consumer. Just what this means may be realized when one considers that there are five or six different styles of bases called for; the voltages may vary to the number of forty; five efficiencies are demanded by customers, from 45 to 64 watts, and then to cap the climax the candle powers called for range from 4 to 50, to say nothing of the colored and frosted lamps. If all these variable quantities were carried through all their possible combinations, it would require the lamp manufacturer to carry an assortment of close on to 20,000 styles, each differing from the other in at least one respect. Of course, in practice, this is not done, but nevertheless the varieties now regularly called for compel manufacturers to carry between 200 and 300 varieties; this means a stock varying all the way from a few hundred thousand to close on to two millions, as in the case of the largest manufacturer of lamps in the country.

It would be too much to insist that one single standard lamp should be employed nor could such a lamp meet all requirements of lamp users, but no one acquainted with the lamp business would hesitate to admit that the varieties of lamps now called for could be cut down one-half and more by a judicious system of standardizing. This need not necessarily call for the adoption of a uniform voltage; indeed, such a step would be inexpedient, because in spite of the improvements in lamp manufacture lamps do not all come out of the final process to the exact standard intended. These variations allow of sorting and thus prevent what would otherwise be an absolute loss if one fixed standard were adopted. Indeed, we understand that the lamp voltage adopted by some of the old "parent companies" for their local licensees was expressly selected so that the product of the lamp factories, with all its variations, would find a regular market. But, aside from this, the inevitable drop in pressure in large distribution systems makes it absolutely necessary to have lamps of different voltage on different parts of the system.

The consumer can do much toward lightening the burdens of the lamp manufacturer by reducing the number of varieties in lamps. This will react favorable and in two ways; first, by cheapening the product to the manufacturer and hence to the consumer; and second, by allowing the manufacturer to sort lamps closer to voltage than he can now afford to do.

But while the consumer can aid himself materially by adopting certain standards much of the good which might thereby be gained will be rendered nugatory unless the lamp is given fair treatment. That is to say, a standard lamp ought to be operated at the voltage marked on it, but in how many cases, even among central stations, is this carried out in practice? Every one knows, in fact, that the voltage on incandescent lamp circuits may vary five volts, and more, at different times of the day at the same points; and many isolated plants present even worse conditions. To expect that a lamp can give satisfactory service and a proper light under these conditions would be asking too much of the manufacturer. If to this we add the fact that in but comparatively few plants can the indicating instruments be relied upon within 2 per cent., the difficulties to be contended with will be apparent. Nevertheless, we do not look upon the case as by any means hopeless. The beginning ought certainly to be made in this direction by the lamp manufacturers themselves. They can do much toward standardizing their product, and it would mean dollars in their pockets. Once this is accomplished and the user is properly educated to the method of handling lamps, a new era will have begun and both parties will share in the benefits of standardization. We might suggest as one means of securing the desired end that manufacturers put a distinctly higher price on lamps not conforming to the standards which may be adopted. The remedy would be a drastic one, but we believe it would accomplish the desired end.

LOWERING THE PRICE FOR CURRENT.

MR. R. R. BOWKER, first vice-president of the New York Edison Co., has just issued a circular which has attracted considerable attention throughout the city and on the part of the newspapers, some of which have as usual ventilated their amusingly incoherent and incorrect opinions on the subject. The circular gives notice of a further reduction in the price of current, and it is at once assumed that there is an electric light vs. gas war afoot. As a matter of fact, the policy outlined in the circular by Mr. Bowker is one that has been pursued by his company for a long time past. It is that of lowering the price of current as an inducement to consumption and then of using the greater consumption as a further basis of reduction. Such a method of progressive reduction has nothing to do with the price of gas, even admitting that gas is now placed at a serious disadvantage, although gas itself is cheaper, too. Just when the Edison companies here and in other cities will get down to bed rock in the matter and reach prices below which they cannot go, is not known. The end is certainly not in sight at the present time, and the whole tendency of the art is toward lower profitable rates. In a great many parts of this country to-day 20 and 25 cents per kilowatt is the asking price. The New York Edison Co. must be within touch of from 4 to 6 cents per kilowatt actual. It has adopted a new wholesale rate, not stated in the circular, however, and now proposes to extend its discounts to those who at 1 cent per hour use 5,000 lamp hours per month, or $50 gross bills. These discounts, for prompt payment, are 5 per cent. on 2 hours per day average use of the installation, 10 per cent. on 3 hours, 15 per cent. on 4 hours, 20

per cent. on 5 hours. For long hour users, the company is installing the well known Thomson wattmeter, with some slight modifications.

Various uses of current are referred to in the circular, but one of the most interesting points is contained in Mr. Bowker's reference to the conditions that must necessarily govern price. He says: "As to long-hour use, an electricity supply company is much in the position, regarding prices, of a man who lets saddle horses, and who, to cover the cost of his investment, stable, help, fodder, etc., and make up for seasons and hours when few horses are in use, must get a dollar a day for those he lets. Horses let for ten hours a day, at even so low a rate as 20 cents an hour, pay a profit, while those let for only a single hour, even at a dollar, barely cover cost. Residence lighting, of short-hour use, often suspended altogether when houses are closed in summer, cannot at present be supplied at less than 1 cent a lamp hour without going below cost, while large buildings, using much current for many hours, can be supplied at a much lower price." There is sound reason in this, and we trust that the new departure of the company may help create not only more "long users," but more apparatus that will require current for its operation.

CENTRAL POWER PLANTS FOR THE U. S. NAVY.

GOVERNMENTS are proverbially slow to adopt new ideas in the administration of their affairs, preferring to cling to the old and well-tried methods of the past, but this reproach can hardly be laid at the door of the United States government as regards the application of electricity. The Navy Department has been especially alive to the superiority of electric applications, and our warships are conceded to be, in many respects, better equipped electrically than those of any other navy in the world. While electricity has secured a firm hold on the United States Navy Department afloat, it has net yet by any means reached the limit of its applicability at the other end of our naval establishment. The navy yards are open to vast improvement in this respect, and in his recent annual report to the Secretary of the Navy, Prof. O. G. Dodge, U. S. N., Chief of Bureau of Yards and Docks, points out the great economy which could be effected by the installation in the yards of central stations for the generation of electric power to be distributed to the various shops for the operation of all machinery. Prof. Dodge shows by actual example how the government could save money. Thus, at the navy stations at Port Royal and Port Orchard, a small electric plant at each of these stations installed with the pumping plants could supply power to the present shops. This is also true of the navy yard at League Island, Pa., where he asserts the cost of supplying both power and light would be less than the present cost of supplying power alone. Prof. Dodge, basing his calculations entirely on known data, shows that at the navy yard at Norfolk, Va., at least $12,000 per year, or about 50 per cent. of the present cost of power, heat and light could be saved by substituting a central electric power station for the present scattered plants. And even at Washington, D. C., where the most economical steam plant of any of the yards is installed, a large economy is possible by the substitution of electric power. Prof. Dodge states the case in such a clear and practical way and the intermittent nature of the work at our navy yards is such that none can doubt the truth of his argument. It is sincerely to be hoped that the Navy Department will take up this subject at an early date and as it were, set an example to the country in economical power plant installation. The government will thus not only benefit itself directly, but will indirectly benefit the country by showing how economies can be effected in power installations.

THE RUBBER COVERED WIRE SITUATION.

OPINIONS in the electrical trade and industry vary greatly in regard to the proposed combination in one concern of some fifteen of the largest plants for making "rubber covered" wire. Enough has been said in the public prints to show the reasons for this consolidation and the likelihood of carrying it through. We believe that, in general, the companies in interest are now well committed to the plan, but there are important exceptions, such as Kerite, the proprietor of which, Mr. W. R. Brixey, has come out with an express disclaimer of his intention to sell out. It might not require many Kerites on the outside to endanger the success and prosperity of a concern aiming to do all the business in the rubber covered lines of wire. On the other hand, it is said that at least $500,000 a year will be saved in managerial and selling expenses, which in itself would be a handsome dividend on such a capital as $5,000,000. A case in point is a recent order where eleven principals were on the ground together for about a week, their expenses being estimated at from $1,500 to $2,000. That in itself is an appreciable portion of the possible profit from the order, and so it goes. Then the question comes up whether the customer, even if he does not get a lower price from competition, will not get a better quality with a better responsibility back of it. Every one knows that for some time past the cutting in prices has really imperiled to a dangerous degree the insulating value of the wrappers around the copper wire.

Such are in outline some of the arguments of those active in effecting the consolidation, and they are valid. It remains to be seen how far they will have force. If the plan is successful it will, so far as we are aware, be the first time that any branch of electrical industry has been brought under such control. There is not a single "monopoly" to-day in existence in the electrical field, although there have been consolidations and combinations and "controlling patents" innumerable in every branch of the art and every line of electrical industry. Those active in this new limited consolidation state very strenuously that they intend and expect no other monopoly than a good article at the lowest price possible to the largest facilities.

THE MOTOR IN MODERN FACTORIES.

THE modern tendency toward bringing the driving and driven shafts in as close relationship as possible is developing rapidly into a wave of opinion that is carrying all before it. And no wonder, when results can be obtained such as those experienced by the proprietors of the Mergenthaler Linotype factory, described elsewhere in this issue. What makes this plant particularly valuable as an example is the fact that it permits a direct comparison to be made between the cost of operation of a belted and an electric motor plant.

A system of operation that furnishes as much power as the old plant and, in addition, 1,600 lights, with less fuel than the old steam plant required for power alone, must have merits that make it the unquestioned system of the future. To be sure, in this particular case it required moral courage to rip out an existing and, of its kind, well designed, belted transmission system, but the possible gains were so clearly discernible that they foreshadowed a return on the investment which has already been amply confirmed. The plant is conspicuous by the fact that all the motors are direct connected to the ends of the shafts driven throughout the entire works. Both the Mergenthaler Company and Mr. E. R. Knowles, their consulting electrical engineer, are to be felicitated on the splendid outcome of this undertaking.

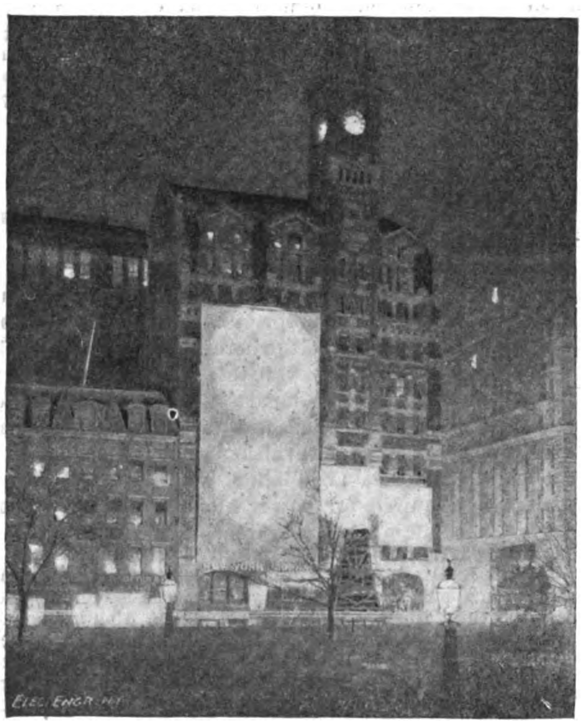
ONCE MORE THE HEILMANN.

CABLE dispatches from Paris announce another and successful test of the Heilmann locomotive, which, it will be well remembered, is a generating plant on wheels delivering its current to the motors that drive on the axles of the whole combination. The statement also comes that the directors of the Western Road are going to adopt it. This is, we imagine, rather open to doubt, if the dispatch means the immediate equipment of the whole road of 2,269 miles, for although the train weighed 200 tons, the speed was only 18 miles, and our own idea is that the trend of electric railway work is rather in the direction of splitting up these large trains and running them in much smaller and lighter units or in multiples of units, each of which has its own motor. There are other points of criticism interesting as the Heilmann experiment undoubtedly is. Meantime, we must agree with the opinion expressed by Colonel H. G. Prout, editor of the "Railroad Gazette," in an article in the New York "Times:" "The reader can safely rest in the assurance that the Heilmann locomotive will not be adopted by the Western Railroad of France or by any other great railroad for any other than very limited and special work like, for example, the work now done by the big electric locomotives in the Baltimore & Ohio tunnel at Baltimore."

ELECTRIC LIGHTING

THE ELECTRIC LIGHT IN ELECTION RETURN WORK.

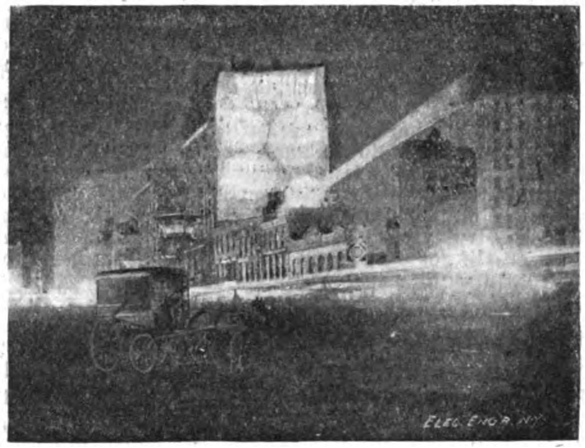
LAST year considerable space was devoted in the pages of The Electrical Engineer to a description of the manner in which the election returns were bulletined by the various newspapers in front of their respective buildings, with the help and accompaniment of the electric light. This year the work was not less interesting, and in one instance was on a scale of magnitude surpassing any previous effort. A brief account of the work done for the New York "Journal" by J. B. Colt & Co. will give our readers an idea of the enterprise, ingenuity and money that a newspaper, not allowing itself to be hampered by conditions of any kind, can throw upon such work. The story is, indeed, a chapter in the development of modern journalism in America, as it shows very strongly the



DISPLAYING ELECTION RETURNS, JOURNAL OFFICE, CITY HALL SQUARE.
(Copyright; from photograph taken by J. B. Colt & Co.)

trend of the effort made by a pushing paper to advertise itself in a field already well occupied by strong competitors.

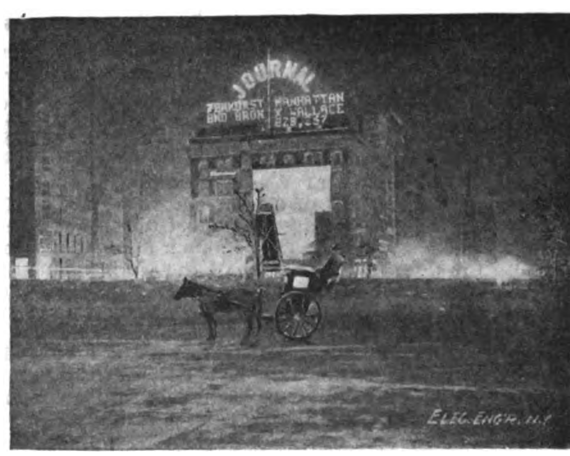
The "Journal," in starting out to "beat creation," casting around for the concern to do it, made a contract with J. B. Colt & Co., of Nassau stret, New York, who assigned their Mr. R. C. Daniels to take charge of the whole campaign. He and Mr. E. Z. Gerould, of the "Journal," planned all the details. A great deal of preliminary work was necessary, but when election night, November 2, came, everything was ready and the "Journal" was in position at five different strategic points, one in Brooklyn, and four in New York, with a disposition of forces under Mr. Daniels like those of a general in the field. Over in the City of Churches a huge screen, 60 feet long and 30 feet high, was operated, along the side of the Tobias Clothing Building, at Fulton and Liberty streets. At the top of the store was placed another screen 12 feet high and 40 feet long, upon which one stereopticon was concentrated, all the time, with the word "Journal." Upon the main screen below two discs, each 30 feet in diameter, were thrown with returns, one of the discs alternating with the "animated pictures" of the biograph. The tower in front for projection was three stories high, the lowest one carrying the biograph, the second the telegraph operators and slide writers, and the third the projection instruments, three in number. All these instruments were of the Colt "Criterion" type, but special build, with 6-inch condensers, and burning three-fourth inch soft cored Electra carbons, each lamp taking 75 amperes and 110 volts across the Edison 220-volt circuits. Adjoining the tower the Twenty-third Regiment band of Brooklyn was stationed to fill in the pauses with popular airs. The whole display at this



ELECTION RETURNS, SOUTH SIDE OF MADISON SQUARE.
(Copyright; from photograph taken by J. B. Colt & Co.)

point was under the charge of Mr. Ernest Unger, superintendent of the Colt Company's factory.

Crossing the Brooklyn Bridge to New York the "Journal" was again very much in evidence on City Hall Square, where in front of its own offices in the "Tribune" building, it had, as shown, a most complete equipment. The facade of the well known structure was pretty well covered up with the sheets, and before them stood a huge 4-story tower like a tall lighthouse. On one deck was the biograph, on the second the slidemakers and telegraph operators, on the third the projection instruments and on the fourth a special projection searchlight devised by Mr. Goodyear, of the Colt Company. This lamp used 1-inch "Electra" carbons, with 100 amperes and 8-inch condensers, and threw special signs and sayings all over the place, focussing, if necessary, hundreds of feet away, with a sign 10, 20 or 50 feet, as might be desired by the operator. The screen for the returns was no less than 125 feet high and 50 feet wide, allowing for two 50 feet circles, and for the biograph at the bottom. Besides projecting the returns as they came in, there was a third projection lantern which kept tally



ELECTION RETURNS, NORTH SIDE OF MADISON SQUARE.
(Copyright; from photograph taken by J. B. Colt & Co.)

on the total vote for each prominent candidate. Mr. W. E. Colt was the commanding officer at this point of seething, throbbing interest, around which crowded thousands of excited citizens, and he kept his batteries playing on the screens from 5 p. m. until 1:30 a. m. Then the storming party went home and fell into bed, dead tired out.

Up town at Madison Square the "Journal" had both the north and the south ends of that great open space, occupying the two big blank walls so familiar by the advertising uses to

every New Yorker. On the south end, the Cumberland wall was covered by a huge screen, on which were thrown three discs for returns, and one projection microscope in which, to amuse the crowd, were placed live flies, bugs, etc. On top was a permanent stencil in light of the "Journal." In addition there was a flying projection light of the Goodyear type mentioned above, which threw around broadcast on wall and roof its legends of victory and was also employed effectually to box up with its beam the light of another search lamp which had at first been turned upon the "Journal" outfit with an idea of hindering its work. Mr. E. P. Hopkins was at this point in charge of the staff.

Up at the north side of the square, on the Worth Building, there was a three-story tower, in the triangular space on the street crossing there, and this was equipped with one biograph and two stereopticons, and three operators. These lamps, like the others, took 75 amperes from the Edison mains. The screen was 25 feet high and 50 feet long for the biograph and below was a 25-foot screen with single disc for the returns. A band was also in attendance. Right on top of the building was an equipment to show the Crandall electric lettering, the letter standards being mounted above the cornice on the south front. The letters were operated from a room on the roof, 6 feet long and 12 feet wide, with 42 letter and number keyboards around three sides. In this room were a telegraph operator and a long distance telephone man. As the manipulator received the news he went to each keyboard and clamped down the letter. When the bulletin was complete current was switched in and the sign then shone out on the dark sky. Besides all this there was a steam siren with a shrill scream which was let loose frequently and made itself heard above all the other din. Nor was this all. From the south side of West Twenty-third street, at the corner of the Square, during

SHOWING ELECTION RETURNS IN BROOKLYN.
(Copyright: from photograph taken by J. B. Colt & Co.)

the afternoon huge kites were flown, carrying portraits, and at night the beam of the searchlight was constantly thrown on the successful candidate.

At 125th street and Madison avenue Colt & Co. had two screens for the projection and biograph. Here rather interesting conditions were met. Sixty cells of chloride battery were furnished by Mr. Bunce to run the motor of the biograph, as only the alternating current was available. This current was used for the projection lamps, with 60 amperes of current, through three-fourths-inch "Electra" carbons. The work at these two adjacent points was in charge of Mr. E. L. McIntosh and Mr. F. O. Congdon, and the returns were given promptly to thousands of Harlemites all through the hours of excitement.

It has already been stated that the general management of this work was in the hands of Mr. R. C. Daniels. That gentleman went the rounds from point to point all the time in a carriage, and kept his horses on the gallop, as he swept from one point of action to the other. Each of his towers was in fact a temporary but very strong house, being walled in and equipped with tables, chairs, etc. The rheostats of the lamps helped warm up the operating rooms, but not coffee was served to all. Besides the work on the screens, the "Journal" called upon Mr. Daniels for other advertising work. It was not enough to throw bulletins on the white sheets or beams of light up in the air. There were big volleys of fireworks, and a gratuitous distribution of no fewer than 25,000 "Journal" megaphones from that paper's news wagons. These megaphones were of very simple construction, a roll of stout paper held in cone shape by brass fasteners, but they had a very high efficiency, like all the rest of the outfit. In short, it is certain that the work was never attempted on such a scale before and never carried out with equal brilliancy and perfect finish in every detail. That it cost many thousand dollars and was worth every cent, goes without saying.

ELECTRIC TRAIN LIGHTING TRIALS ON THE LONDON & NORTHWESTERN.

AMONG other railway companies, the London & Northwestern has been making successful experiments with electric light in their railway carriages. It has been tried, says the London "Electrician," on the sleeping saloons of one of the Scotch expresses and of the Irish mail, and more recently it has been fitted in the carriages of a passenger train running between Euston and Watford. Messrs. J. Stone and Co.'s system has been used. A small two-pole dynamo is suspended by a link from the underframe of the coach, the link being attached to a corner of the magnet-casting of the dynamo. The 4½-inch driving pulley of the dynamo is connected to a 15-inch pulley on the carriage axle by means of a belt, and the diameter of the wheel is 3 feet 6 inches. The suspended link is so adjusted that the driving belt draws the dynamo out of the diagonal position in which it would naturally hang, the weight of the dynamo putting a definite tension on the belt. This tension is regulated by the position of the suspension link, which is adjusted by means of a tension screw. The adjustment is so made that at a certain speed—1,100 revolutions per minute—of the dynamo the belt slips. The dynamo is connected to one of two batteries of accumulators through an automatic switch, the functions of which are many and the parts of which are few. By means of a centrifugal governor mechanism on the motor spindle, the dynamo is not switched on to the cells until a carriage speed of 15 miles an hour has been attained. Before this speed is reached the lamps are connected to the terminals of one of the sets of accumulators. As soon as the rocking switch, actuated by the governor-mechanism comes into action the dynamo is connected to the accumulator terminals, and a resistance of iron wire is inserted between the cells and the lamps to compensate for the increased e. m. f. The dynamo is shunt-wound, and the contacts connected to the field winding project beyond those connected to the brushes, so that the magnets are excited by the cells before the armature is in circuit with them. The direction of rotation of the motor corresponding to a forward direction of the carriage connects the dynamo directly to one set of cells, and that corresponding to a backward motion connects it to the other set. The two sets of cells are connected in parallel through the iron-wire resistance coils above referred to so long as the dynamo is generating current, but as soon as the train is at a standstill or running slowly, these coils are short-circuited. Even the lubrication of the dynamo is governed automatically. There is a large oil reservoir, but the outlet is not opened unless the dynamo is generating current, when the flap covering the hole is lifted by an electromagnet. The number of cells forming each battery is 8; they are of the E. P. S. 15-plate type. There are two 8 c. p. lamps in each compartment of the carriage, and they are wired in separate circuits, so that one, both or neither are on, according to the position of a switch at the end of the carriage. In one compartment is an ammeter showing the total current generated by the dynamo, and the tension-screw of the belt above referred to is adjusted until the current is 25 amperes at full speed. The box in which the switch is placed also contains fuses. There is one of the latter in each lamp circuit, but none on the dynamo side of the switch. At present, three different types of belt are being tried—an ordinary link belt, a canvas and rubber belt, and, thirdly, a canvas belt with cross-strips of leather. The inconvenience of having to carefully adjust the belt tension at frequent intervals appears to be the only drawback to the system, as otherwise it requires practically no attention, and is, besides, quite self-contained. Its first cost is naturally higher than that of oil lamps, but probably not higher than that of the complete apparatus necessary for the Pintsch gas system, while it is indisputably safer than the latter. It would, however, be interesting to compare its first cost and working cost with that of a simple accumulator system with an independent charging station.

DUNKIRK, N. Y., proposes to add to its municipal lighting plant a dynamo to furnish incandescent lamps for the city buildings.

BROOKLYN NAVY YARD.—A successful test has been made at the yard of the operation of gun turrets by electric motor on the cruiser Brooklyn. The Ward-Leonard system is used.

TELEPHONY AND TELEGRAPHY

THE HOFFMAN "TELESCRIPTEUR."

THIS is the name given to a printing telegraph instrument invented by M. Hoffman, who was formerly employed by the Agence Havas, the well known European News Agency. The instrument, which was recently tested in Berlin, has aroused considerable comment abroad. The telescripteur, a front view of which is shown in Fig. 1, consists of a keyboard,

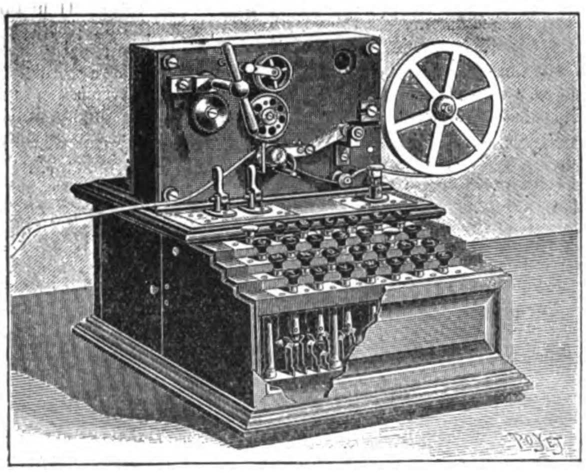


FIG. 1.—THE HOFFMANN TELESCRIPTEUR. FRONT VIEW.

which makes contact when the key is pressed, and sends momentary currents into the line. These act upon the polarized magnet seen in the rear view, Fig. 2, which controls a clock escapement. The spindle of the clock movement carries a brush passing over a sunflower distributer, with twenty-eight contacts, and to the same spindle is fixed a type wheel. A narrow paper tape receives the impression in the usual way.

The telescripteur may first act as a simple writing machine. The calling station depresses the two levers seen in Fig. 1 above the keyboard, and the receiving station lowers the first of these two levers. When currents are transmitted, both instruments record, the operator merely depressing the keys in the usual way, the tape being fed the proper distance after each letter is printed. When the receiving instrument desires to transmit,

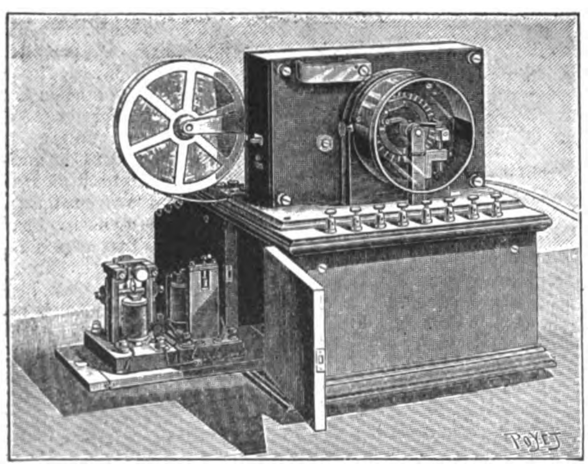


FIG. 2.—THE HOFFMANN TELESCRIPTEUR. REAR VIEW.

the levers are depressed in the manner corresponding to that just mentioned above.

This printer is able to transmit 120 letters per minute. It can also be combined with the telephone, the same wires serving for that purpose, and the telephone or the printer being used as desired by the simple shifting of a switch. The apparatus seems to have evident application where it is desired to receive and record messages during the absence of the party called. We are indebted to "La Nature" for the engravings.

ELECTRICAL BOSTON THIRTY YEARS AGO.[1]

BY THOMAS A. EDISON.

THINKING that a description of the different manufacturies of telegraphic and electrical apparatus in the "Hub" might be interesting to some of your many readers, I have prepared the following, the first on the list being the shops of Messrs. Edmands & Hamblet, 40 Hanover street.

This firm[2] is well known to the public and telegraphic fraternity as the manufacturers of the "Magneto-Electric Alphabetical Dial Telegraphs," of which a large number are used upon private lines in different parts of the country. This telegraph is constructed upon the magneto-electrical principle, and dispenses with the voltaic battery. The following is a brief description of this admirable apparatus: The transmitter is contained in a small square box, upon which there is a dial plate, with a circle of thirty equidistant keys or buttons radiating from the same center. Upon the dial plate are marked the alphabet, three points of punctuation and an asterisk; in an inner circle are the numerals. A pointer in the circuit rotates in connection with the hands of the rotating armature, and is stopped at any letter by depressing one of the buttons. A fixed compound permanent magnet with four soft iron cores with their coils of wire are fixed upon the poles of the permanent magnet, equally distant from each other in the circumference of a circle. On an axis passing through the center of this circle in connection with the handle, revolves a soft iron armature, whose breadth is a little greater than the distance between two adjacent cores. When the armature revolves it approaches one pole as it recedes from the one diagonally opposite, and induces simultaneously in the two coils currents having the same polarity. Immediately under the transmitter is an arm upon the same axis as the pointer above whose motion is arrested when a button or key is depressed and the current, which would otherwise pass over the wire is "short-circuited." The face of the indicator is similar to that of the transmitter, having a small pointer which is thrown around from letter to letter by a very curious and delicate escapement in connection with a polarized magnet similar to that invented by Siemens, and which is actuated by currents of different polarities generated by the permanent magnets.

The coils of the indicator and permanent magnets are connected in one common circuit. When the armature of the magneto is turned around by means of the handle, if the pointer is free to move round the dial, a current traverses the line of every letter which the pointer passes and moves the hand of the indicator correspondingly, but as soon as the carrier-arm on the same axis as the transmitting pointer is stopped by coming in contact with a depressed key, the currents which would follow are "short-circuited." The pointers of the transmitter and indicator therefore stand still upon the same letter until the key is raised and the "short-circuit" removed. Alarm or call bells are also attached in such a manner that when no communication is being sent the indicators are cut out and the call bells cut in circuit and vice versa. To operate it no knowledge of the usual telegraphic signs or sounds are necessary; the operator simply places his fingers upon the letters of the alphabet, which compose the telegram, and the person receiving simply takes notice of the letters as they are successively pointed out upon the indicator at the other terminal.

Several trials have been made with the instrument over the wires between this city and New York to determine their applicability for railroad wires, all of which have proved highly successful. The working of the beautiful instrument, as well as the neatness with which it is constructed, and its advantages over the clumsy apparatus for similar purposes of a foreign manufacture, cannot be too highly spoken of, as it shows that America can successfully compete with Europe in the manufacture of telegraphic apparatus, even if they are turned out of the shops of a Froment or Siemens-Halske.

This firm also manufacture another piece of curious electrical mechanism which is called "Hamblet's electro-magnetic watch-clock," which is in use in nearly all of the fire alarm offices, hospitals, prisons, in the Union and in a large number of the principal manufacturing establishments of New England. It is for recording the rounds of a night watchman every hour, or half hour, which it does upon a paper dial marked with the hours and subdivisions of time similar to the dial of a common timepiece, and which is made to revolve in such a manner as to receive the impress of a lead pencil bear-

[1] This is an article prepared by Mr. Edison for a newspaper while he was a Western Union night operator in Boston. It gives a most interesting idea of the concerns making apparatus in Boston at the time, and of their specialties.

[2] One of the partners in this firm was Mr. James Hamblet, now of the Western Union time service in New York City, to whom we are indebted for the use of Mr. Edison's manuscript. The date is 1868.

ing thereupon, which, as time passes, makes its mark upon the paper.

The electric current being in the quiescent state of the electrical mechanism, open, (i. e., not actuated at the point of operation) will cause the pencil to make a regular continuous line, which in twelve hours would form a perfect and unbroken circle within the dial.

The instant that the watchman touches a simple piece of mechanism at any point upon his beat upon which there are several, he causes the circuit to be opened and closed, and the pencil advances a degree toward the center of the paper dial, leaving its impress as it advances, and then commences its mark on a new concentric parallel, and this action is repeated as often as, and whenever the apparatus is operated upon at different points in the circuit. An angular record is thus produced, which on comparison of the angles with the marks of subdivision of time, will show, not only that watch duty has been done, but will also show the exact time that each point has been visited. When a watchman operates the last point on his round the pencil falls back to its original level, and is ready for the next round.

If the pencil marks are all regular and similar in the different hours, it is proof that the twelve hours' watch duty have been performed. If, on the contrary, there are irregularities in the angles, they will be evidence that something has occurred.

This apparatus may be seen in nearly every fire alarm office in this country, where perhaps many of your readers have seen it in operation.

In this establishment is also made the "Electric Plural Time Dial," an ingenious contrivance by which the time indicated by one standard regulator clock is shown upon any number of duplicate time-dials or electric clocks situated at any distance from each other, and all connected in one electric circuit. The most curious part of this system is that the duplicate clocks have neither springs, weights, nor train of wheels to produce a movement of the index, but contain a simple, though curious escapement operated by an electro-magnet in the regulating circuit. They therefore require no winding up or attention. Another curious piece of electrical mechanism is also manufactured by this firm, called the "Electric Pendulum Gauge," for measuring and recording the varying heights, depths and quantities of gas or water in reservoirs, but it is of too complicated a nature for an accurate description without the aid of drawings. This apparatus has, after a series of severe tests, been adopted by the Boston Gas Company.

Electric wind indicators, astronomical clocks and apparatus, chronographs, printing telegraph instruments, repeaters, galvanometers, electrometers, philosophical apparatus, fire alarms and every variety of magneto-electric and electro-magnetic mechanism are also manufactured by this firm, all of which compare favorably, if not excel, any similar mechanism of foreign manufacture. Twelve persons are employed here, among whom are several of the best mechanicians in the country. Telegraphers visiting the "Hub" would do well to call at the office of Messrs. Edmands & Hamblet, where all the apparatus described may be seen in actual operation.

The next on the list is that of Charles Williams, Jr., 109 Court street.

The shops of Mr. Williams, though but a short time since damaged by fire, are again in full blast. Very little apparatus except that used for telegraphic purposes is manufactured here, and in this particular branch the work is of a most excellent character, consisting of repeaters, switchboards, relays, registers, sounders, keys, rheostats, galvanometers and batteries, all of which are made in large quantities. The most noticeable instrument manufactured here is the well known "Boston Relay," of which an immense number are turned out weekly, mostly for use on railroad wires. Ten men are employed here. The office of the well known electrician and telegraph inventor, Moses G. Farmer, is also at this establishment.

The next is H. B. & W. O. Chamberlain, 310 and 312 Washington street, manufacturers, dealers and importers of mathematical, astronomical, chemical, electrical and philosophical apparatus. This establishment is probably the largest and best of its kind in the United States. Every conceivable form of experimental apparatus appertaining to the above mentioned sciences can be found here. This firm have recently imported a large number of monster induction coils from the shops of Ruhmkorff, of Paris, one of which is probably the largest in this country.

The next is Ritchie & Son, 149 Tremont street, manufacturers and importers of philosophical and electrical apparatus, similar to that of the Messrs. Chamberlain. Mr. Ritchie is known to the scientific public as the inventor of several important improvements on the original form of the Ruhmkorff or Page induction coil, and as the maker of the largest and most powerful induction coil hitherto constructed, now in the possession of M. Gassiot. A description of this coil may be found in Noad's Manual of Electricity, page 326, and in the "Philosophical Magazine," Vol. XV., p. 466.

The last is Thomas Hall, 19 Bromfield street. Very little telegraph mechanism is manufactured at this establishment, being almost exclusively devoted to the manufacture of electrical toys and medical electrical machines.

GOVERNMENT TELEGRAPHS IN ENGLAND—ANNUAL ROPORT.

The British Postoffice has recently issued its annual report for 1896, which contains as usual the figures relative to the telegraph and telephone service. We note that the number of telegrams forwarded was 79,423,556, being an increase of 583,946, or 7.4 per cent. over the number for 1895. It is pointed out that this number exceeds by 2,000,000 the number of letters, other than "franks," passing through the post in the year in which the Queen came to the throne.

The revenue from inland telegrams was £2,070,045, as compared with £2,046,456 for the previous year; and the average value 7.58d. per telegram, as compared with 7.61d. for the same period, 1895.

In foreign telegrams there was a decrease of 393,851, or 5.87 per cent. Of press messages there was a decrease of 77,945, or 1.31 per cent., the total number being 5,837,701. The average weekly number of words contained in these telegrams was about 13,471,618. Telegrams transmitted under the free message terms acquired by certain of the railway companies amounted to 1,371,406, an increase of 2.43 per cent., as against an increase of 27.74 for the preceding year. London local telegrams show an increase of 343,072, or 4.92 per cent.

The transfer of the telephone trunk lines acquired from the National Telephone Company commenced on April 4, 1896, and was completed on February 6, 1897. The mileage of trunk wire erected by the department itself, up to the end of the year, was 19,620; the mileage transferred from the National Telephone Company was 29,000, making, with the 4,180 miles in the course of construction, a total mileage of 52,800. The telephone system now consists of over 880 separate trunk circuits, supplemented by more than 2,000 circuits between post offices and the National Telephone Company's exchanges. To meet the cost of these lines an expenditure of £300,000, in addition to the £1,000,000 authorized under the Telegraph Act, 1892, has been sanctioned.

The main arteries from London to the provinces having been already occupied by wires, an underground line is to be laid down between London and Birmingham. This work is estimated to cost £165,000, and of this £65,000 will be spent during the current year. This underground route, when completed, is to provide for a telegraph service, and so set free certain ærial wires now in use for telegraph work, in order that the pole space occupied by them may be available for telephone circuits.

In coast communications much progress has been made on the Devon, Cornish and Welsh coasts, on the northeast coast of England, and the coasts of Scotland and Ireland. The maintenance of the lightship cables still presents some difficulties, while "the experiments which are being made with a view to ensuring communication with lightships by other means than continuous cables have not, as yet, been brought to a definite conclusion."

Again we are told of a loss on the telegraphs of £140,714. The percentage of combined salaries and wages to combined revenue has increased from 38.66 in 1886-7 to 45.62 for 1896-7, and the percentage of combined salaries and wages to combined expenditure has increased for the same period from 50.94 to 60.70. On the other hand the increase in the total number of telegrams on the number rendered for the year 1886-7 has been 58 per cent., and the percentage of increase on the total value of telegraph work performed, 43.

WESTERN UNION RATE FOR GOVERNMENT TELEGRAMS.

Postmaster General Gary has approved the report to the Court of Claims of First Assistant Postmaster General Perry S. Heath, as sole referee in the case of the Western Union Telegraph Company against the United States, involving a large claim for government telegraph tolls under the Wanamaker rate, and accrued under the Harrison administration. Mr. Heath's report found that there was due to the company $258,869. This represents the difference between the rates paid prior and subsequent to the adoption of the Wanamaker

rate. It is understood that Postmaster General Gary having confirmed the finding of the referee, the government will enter no defense to a judgment in the Court of Claims, except to waive an acknowledgment that this would permit any one to question the right of the Postmaster General to fix any arbitrary rate.

MUNICIPAL AFFAIRS

AN ENGLISH VIEW OF THE DETROIT MUNICIPAL PLANT.

An interesting digest of the figures of the Detroit Municipal Lighting plant appears in the London "Electrical Review" of October 29. It is pointed out that the plant will furnish 2,000 arc lamps of 2,000 c. p. each, with 1,564 running at the time of the report, and 3,000 incandescents of 16 c. p. The arcs run on an average of 10½ hours daily, or a total of 3,791 hours per year. The "Review" says: "The total cost is approximately £19 per arc lamp per annum, which seems very high, considering that the output was nearly 3,000,000 units and the load an all night one of the most favorable character. It is but slightly less than the average contract price paid to private companies, yet we are told that the plant is "very well built and organized." If this be true, it is not surprising that the opinion should gain ground that American municipalities as a rule have nothing to gain by handling their own plants." The "Review" does not profess to understand why this should be so compared with England, where it assumes things to be different. It goes on to note: "It is interesting to remark that the Detroit Public Lighting Commission have only calculated depreciation on the boiler plant; everything it assumes is kept in a state of perfect repair, and therefore no depreciation need be allowed. This is illogical, but it is on a par with the reasoning of one of our local authorities which equally ignores the difference between maintenance and depreciation."

PHILADELPHIA GAS BILL SIGNED.

Mayor Warwick, of Philadelphia, on November 12 signed the bill recently passed by the councils leasing the city gas works to the United Gas Improvement Company. The terms of the lease are that the United Gas Improvement Company is to pay a rental of $1,000,000 a year for thirty years, and to spend $5,000,000 on the improvement of the gas works. The value of the plant is estimated at $30,000,000. The city has been operating on a basis of heavy net loss, and for a long time past has been buying gas from private plants to sell again.

THE STORY OF CHICAGO'S MUNICIPAL PAVING.

Chicago's experience in street paving is only a duplicate, of course, of conditions elsewhere, but it seems the more startling in Chicago, because of the larger sum wasted. Within the last eight years the Western city has expended for pavements over $32,000,000, and yet, according to one of its prominent and well-informed citizens, it has the unenviable distinction of having the most poorly paved streets of all the large cities in the world. This result is ascribed more to ignorance than to venality. There has been some stealing. Chicago papers admit that in a matter-of-fact way, and one of them estimates the thefts at 10 per cent. of the appropriations. Another 10 per cent. of the appropriations is estimated as affording some return for the investment, while $800 in each $1,000 is regarded as having been thrown away on poor work. Through incompetent engineers and incompetent or venal inspectors, the city funds have been used to enrich the contractors, while poor paving remains as a tax on commerce and a menace to health.

ALMEDA'S PLANT A FAILURE.

Municipal ownership of electric lights is not always a success. For example, the Almeda "Argus" says: "This city spent more than $42,000 on its light plant last year, $22,000 the year before, $27,000 the year before that, and is likely to spend more than $20,000 this year. The municipality could buy all the light it uses for $10,000 a year at the outside. The light it sells is undoubtedly sold at a loss. As a business venture Almeda's experiment is a rank and wretched failure."—San Jose (Cal.) Mercury.

NEWS AND NOTES

THE RHODIN ELECTROLYTIC PROCESS FOR ALKALI AND BLEACH.

The Rhodin electrolytic process for the manufacture of alkali and bleach, the invention of Mr. J. G. A. Rhodin, of Manchester, was recently demonstrated on a small scale in London by means of a model, illustrations of which are shown in the accompanying Figs. 1, 2 and 3. Our English contemporaries say that works are in process of erection for the commercial manufacture of caustic soda and bleaching powder

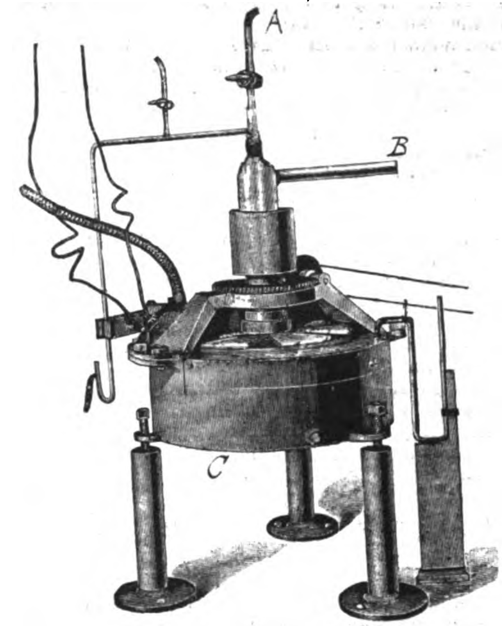
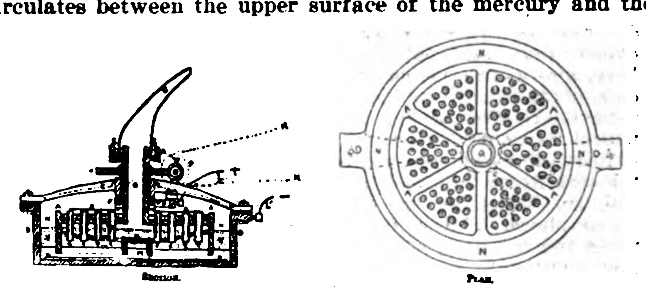


Fig. 1.—Rhodin's Electrolytic Apparatus.

from brine by this process. The electrolysis of brine is carried on in the cast-iron cylindrical vessel C, the bottom of which inside is lined with wrought iron. A layer of mercury on the bottom forms the negative electrode, while the carbon electrode consists in a large number of short, vertical carbon rods projecting downward from a rotating disc-shaped holder or cover, this cover being of vitrified earthenware. The brine is fed through the pipe A, and the spent liquor passes away through a pipe not shown in the figure. The layer of brine circulates between the upper surface of the mercury and the



Figs. 2 and 3.—Rhodin's Electrolytic Apparatus. Section and Plan.

carbon rods, and as the earthenware cover rotates the mercury is stirred so as to renew the surface exposed to the deposition of sodium.

The action of the cell is as follows: The layer of mercury forms a lute or seal with the downward projecting edges of the inner earthenware vessel, so that when the inner vessel is filled with brine, and the outer annular space is filled with pure water, no connection between the liquid contents of these two portions of the cell can possibly take place. When the electric current passes through the cell the current passes from the lower end of the carbon cylinders to the surface of the mercury. The chlorine is given off at the surface of the carbon poles, and is carried away through the central tube B

to the bleaching powder chambers. The sodium amalgam forms on the surface of the mercury in the inner portion of the vessel at the bottom surface of the brine, and passes partly by diffusion and partly by the mechanical agitation of the mercury, occasioned by the revolution of the inner vessel, to the outer annular space, where the layer of water extracts the sodium in the form of caustic soda. The mechanical agitation is assisted by placing radiating vanes in the bottom of the containing vessel, and these conduct the mercury to the outer edge of the vessel.

In actual working the iron vessel is heated externally to such a temperature that the liquid contents of the cell are raised to a little short of boiling point, and this not only prevents the absorption of a large amount of chlorine in the brine, but also very much increases the efficiency of the water in taking out the caustic from the amalgam, as well as reducing the electrical resistance of the liquid film between the lower surface of the carbon cylinders and the surface of mercury. In consequence of the low resistance in the cell the voltage of the electric current which is required to drive the current through the cell is very small, and is stated to be not higher than 3.3 volts per cell.

The following are among the advantages claimed for Mr. Rhodin's electrolytic apparatus and process:

1. The process is a continuous one, with a single anode chamber, costs less to construct, and gives results which far exceed any existing process. 2. The construction of the apparatus is such that it lends itself perfectly to the application of heat, a most important point, because the quantity of work which can be accomplished by the current when the electrolyte is hot is very much greater than when used on cold solutions. 3. The total absence of any rocking motion, no pumps, or circulation of mercury. 4. There is practically no loss of mercury. 5. The high efficiency obtained. 6. The low potential necessary to effect decomposition. 7. The ease of renewal of anodes, and the minimum destruction of same. 8. The apparatus, in addition to its use for the extraction of metals, soda, potash, and other alkaline salts, can also be successfully used for the electrolytic production of a large number of other chemicals, such as nitric acid, chloroform, naphthaline, nitro-benzol, aceto-acetic ether, etc.

ELECTRIC FLOUR MILLS ON THE PACIFIC COAST.

SINCE the completion of the great three-phase electric power transmissions on the Pacific coast, between Folsom and Sacramento and the San Joaquin and Fresno, the use of electricity as a motive power has made great strides. Two of the most important flour mille are now added to the already long list of consumers.

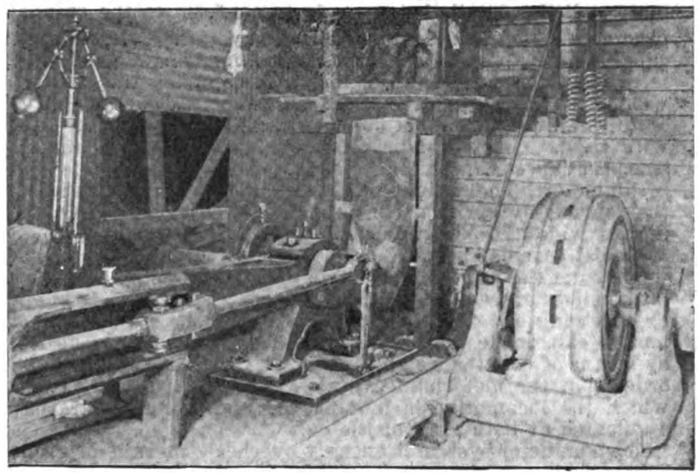
The first to place its dependence on electric motors instead of the steam engine was the Sperry Flour Mill, of Fresno. This is driven by a General Electric synchronous motor of 150 k. w. capacity, running at 600 revolutions. This motor has a small bipolar motor to bring it up to speed, in the basement of the mill, whence the main belt passes to the rolling and grinding machinery above.

The next mill is the second in importance on the Pacific coast and the largest flour mill in the United States using electricity instead of steam. Its electrical equipment consists of three General Electric 3-phase alternating current induction motors operating at a pressure of 500 volts. The largest of the three motors has a capacity of 75 h. p. This is belted to the main shaft of the mill and drives all the flour making machinery. It runs continuously for 24 hours, and for three months without stop. The second largest motor is one of 30 h. p. This occupies a position on the second floor of the mill and drives all the cleaning machinery. It runs continuously for eighteen hours daily. The third is a 20 h. p. motor and is placed in the basement near the 75 h. p. motor. This drives the roll for grinding the corn and the barley. Its work is intermittent and it runs from 8 to 10 hours per day only.

The power consumed by the motors is registered by means of recording meters, which show the total horse power of current consumed. These meters register exactly the power used and allow the company to keep a careful watch upon their machinery and obtain the highest economy in operation. For instance, when the cleaning for the day is completed and the 30 h. p. motor and all the cleaning machinery are shut down, all expenses for power in that department cease at once. No power is wasted in running idle shafting and belting. The same is true in a still greater degree in the corn and barley crushing department, where the work is more intermittent.

In addition to the economy, the wear and tear on belts, bearings and machinery is reduced to a minimum by the system of sub-division of power which has been adopted. The cost of hauling coal from the river to the mills, which is in the center of the city, is also saved. It is estimated that the economy in actual power consumed in the Phoenix Mill by the present method of driving is not less than 15 per cent., and the total saving in the entire cost of operation will pay for the electric motors, their installation and adaptation in less than one year.

In addition to the economy in the operation of the mill by the introduction of electricity as the motive power, a considerable amount of space has also been saved, as will readily be realized, and the room formerly occupied by the driving machinery can now be utilized for other machinery or for storage purposes. The present capacity of the Phœnix Mill is 275 barrels of flour and 20 tons of rolled barley and feed every twenty-four hours, and the entire output of this mill is taken by local consumption, none of the product being shipped outside the State. It was due to the careful investigation of the subject



75 H. P. G. E. INDUCTION MOTOR, DRIVING FLOUR-MAKING MACHINERY IN PHOENIX FLOUR MILL.

by Mr. J. H. Arnold, the manager, that electricity was adopted as a motive power. He is already reaping his reward for himself and his company in benefits constantly accruing.

PIPES HURT BY TROLLEY CURRENT IN CHICAGO.

City Electrician Ellicott, of Chicago, has sent to Mayor Harrison a report of experiments made to determine the effect of the current from trolley lines on water mains and gas pipes below the street level in various parts of the city. The report covers a series of experiments made along the trolley lines of the West Chicago Street Railway Company and the Chicago City Railway Company. In nearly every test it was discovered that the pipes had been seriously damaged as a result of electrolysis. In many places the pipes were literally honeycombed and will soon need repairs, which will cost the city many thousands of dollars. The mayor and city electrician will hold a conference to decide upon plans to prevent further damage. The remedy suggested by City Electrician Ellicott is a system of copper wire return circuits to convey the electrical current back to the power houses and a proper bonding of the rails. It is understood that dependence has hitherto been placed on a form of welded bond or joint between the rails, etc.

TALKING THROUGH HIS SHIRT FRONT.

A tall, distingué man, dressed in the very latest style of evening dress, and Inverness cape coat, who sauntered up and down Broadway, visited all the hotel offices and cafes. Wherever he could get into a crowd he would first attract attention by searching through his pockets as if he had lost his watch or some money. Finally, everybody looking at him, he threw out his chest, touched a hidden spring and lighted an electric lamp inside of his shirt bosom, and, presto! the name of a musical comedy stood out in letters red on the linen of his shirt. He would then turn the light out and wander down the street, the perfect picture of a well-dressed man about town.—Daily Mercury.

FRANKLIN'S GRAVE, in Philadelphia, is said by one of the local papers to be in bad shape. The sexton had the name on the stone recut lately, but says that Franklin's descendants will neither do anything themselves nor allow pious admirers to undertake the patriotic task.

ELECTRIC TRANSPORTATION

THE A. E. G. ELECTRIC SWITCHING LOCOMOTIVE.

THE Allgemeine Elektricitäts-Gesellschaft, of Berlin, Germany, have recently gotten out designs for an electric switching locomotive, which possesses a number of novel features. The locomotive, which is illustrated in several views in the accompanying engraving, Fig. 1, is designed for a gauge of 1,435 millimetres, and has two axles, each driven by a motor, all the details being made to conform to the standard practice of the Prussian State Railway. The locomotive is capable of drawing a train of 440,000 pounds at a speed of 4½ miles per hour on the level, and to accomplish this the total weight of the locomotive must be about 28,600 pounds. To obtain this weight ballast boxes are employed, which are filled with sand. The wheel base is 2,500 millimetres, so that the sharpest curves can be taken easily. The wheels are one metre in diameter. The weight of the locomotive is transferred to the journal by springs, consisting of steel lamellae 90 millimetres wide and 13 millimetres thick.

Special care has been taken in the construction of the brake, which is of the Exeter "throw" pattern, and operates with two brake shoes on each of the four wheels. The brake is applied by throwing one of either of the weighted levers in the locomotive cab, while the brakes are released by lifting the lever by means of counter weights, operated by the brake shafts. In order that the motorman can always face in the direction in which the locomotive is moving the regulating apparatus is duplicated at both ends of the cab.

The conductor system is entirely overhead, no rails or ground returns being employed. As will be seen in illustration, Fig. 2, the trolleys on top of the locomotive consist of three aluminum sliding contacts mounted on elliptical spring steel bands. The central trolley is insulated with respect to the two outer ones, whereas the latter are in electrical communication between themselves. The conductors are 8 millimetres in diameter, of hard drawn copper and are supported by insulating clamps at every 20 metres, and are suspended on span wires; the latter are hung from non-insulating clamps, which are attached every 20 or 40 metres to outriggers. The span wires alone are insulated by porcelain insulators; by this method of suspension the span wires also serve as a part of the conductor system.

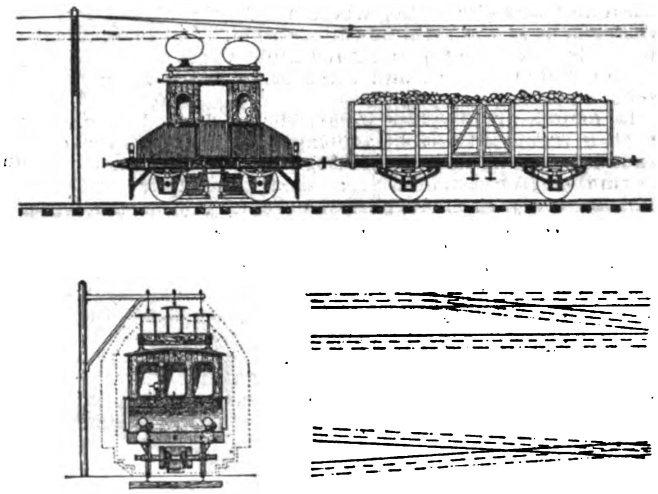


FIG. 2.—ARRANGEMENT OF CONDUCTORS FOR ELECTRIC SWITCHING LOCOMOTIVES.

One of the working conductors is situated above the center of the track and is called the central wire, being designated in Fig. 2 thus: —.—.—, whereas the lower conductors are displaced horizontally about 725 millimetres from the center line of the track, on one or the other side of the central wire, and are called the side wire, being designated in Fig 2 thus: —...—...—. The central wire is placed 190 millimetres above the lateral wire. The lowest point of the central wire is 4,520 millimetres, and that of the side wire 4,330 millimetres above

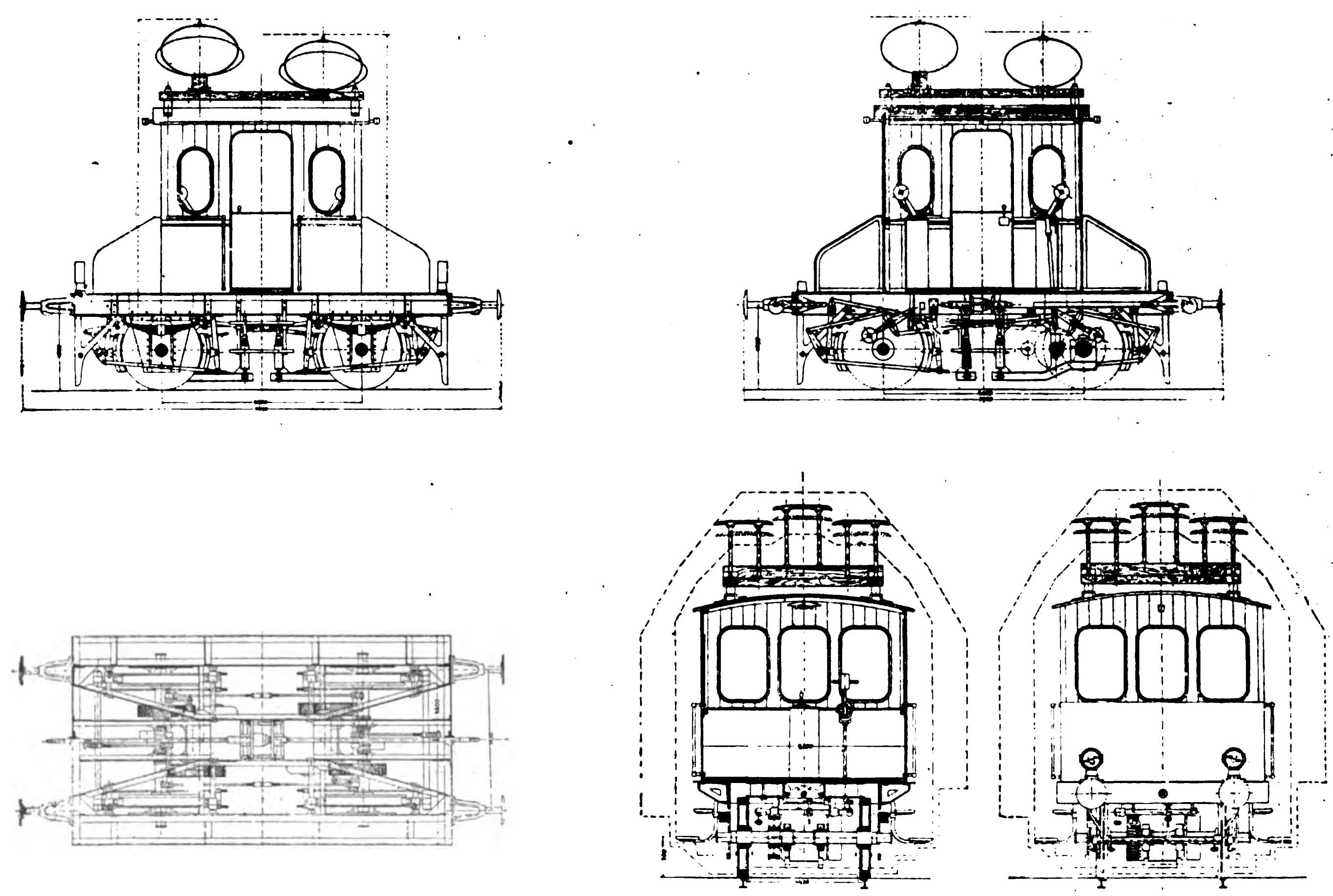


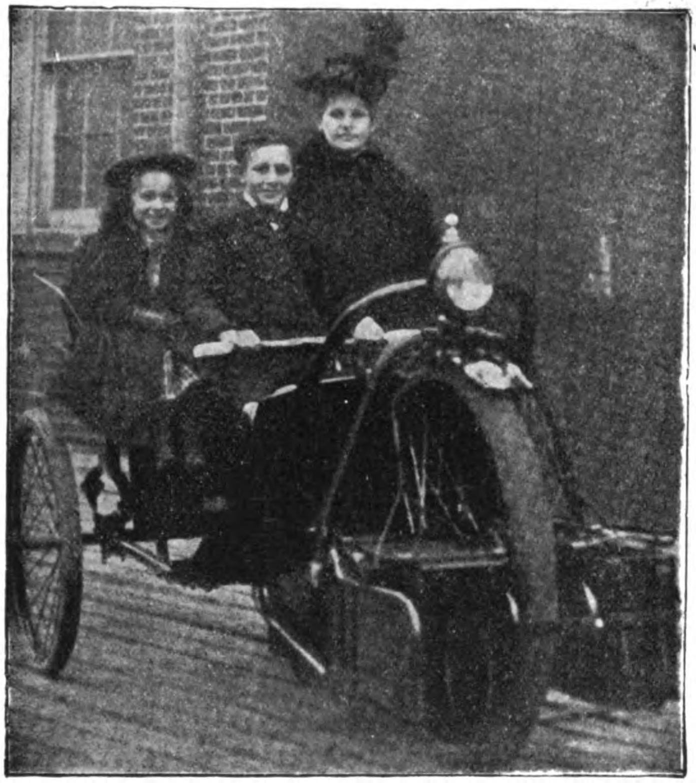
FIG. 1.—ELECTRIC SWITCHING LOCOMOTIVE. DESIGNED BY THE ALLGEMEINE ELECTRICITÄTS-GESELLSCHAFT, BERLIN, GERMANY.

the level of the top of the rail. In general only the central trolley and one of the side trolleys are in actual operation. It is only at switches and crossovers that both side trolleys take current for a short distance, at which points the current changes from one side of the trolley to the other. At such points, however, the central trolley remains in constant contact with the central wire and the non-active side trolleys can pass under the center wire without touching it. The construction adopted entirely obviates all overhead switches and crossovers.

The motors are about 20 h. p. each, with a maximum capacity of 30 h. p. and take 40 amperes at 500 volts. The motors make 600 revolutions per minute and the gear reduction is in the ratio of 12 to 1.

THE BARROWS ELECTRIC VEHICLES.

FOR a long time past Mr. C. H. Barrows has been experimenting in Connecticut and in this city with various types of small and light electric motor carriages, and has done some very interesting work. The C. H. Barrows Company, of 302 West Fifty-third street, New York, is now introducing some of these carriages in a commercial form, and we are glad to be able to illustrate the three-wheeled type, which some of our readers may have seen already. The vehicle shown herewith is able to carry three persons, and the peculiarity consists in making the front wheel portion a motor in itself, towing the rear portion in which the seats are placed. The front wheel is 36 inches in diameter, with 3-inch pneumatic tire, and carries a 1 h. p. motor with 300 cells of a



Barrows' Three-Wheeled Electric Vehicle.

special form of storage battery hung in springs below the axle. An additional 100 pounds of battery is placed under the seat. There are 24 cells in all, weighing with motor and controller about 500 pounds, and of this weight 400 pounds is carried on the driving wheel. The total weight of the carriage is 700 pounds. The motor is geared by a 2½-inch rawhide pinion direct to a 28-inch steel gear bracketed to the rim of the wheel. The controller is mounted in front within easy reach and gives three speeds forward and two backward. The highest speed attainable is about twelve miles an hour. Steering is accomplished as on a bicycle by simply turning the handlebar to the right or the left. Raising the handle applies a brake. The rear wheels are 28-inches in diameter, with 2-inch pneumatic carriage tires, and ball bearings are used throughout. It is said that the carriage will run about three hours at 10 miles or more per hour on one charge of the battery, and that if necessary the battery can be recharged in 45 minutes. Batteries can be exchanged for a charged set in about five minutes.

ANOTHER HEILMANN ELECTRIC LOCOMOTIVE TRIED.

A special dispatch from Paris of Nov. 12 says: "There was a great gathering of European railway men to-day for the first trip of Heilmann's electric locomotive, from Paris to Nantes over the Western Railway. The train hauled by the locomotive weighed about 200 tons. The trial was intended chiefly to illustrate the reduction of vibration and the regularity of movement of the new machine. This was demonstrated, but the speed did not exceed eighteen miles an hour. The principle of the locomotive is simple, an ordinary steam engine working a dynamo, the electricity from which is conducted to motors upon the axles of eight pairs of wheels. The locomotive resembles the hull of a torpedo boat. The wheels are scarcely visible. The locomotive is eighteen meters long and weighs 125 tons. It is regarded as a great improvement on Heilmann's first engine. The directors of the railway company were pleased with the success of the locomotive, and it is stated that they have decided to adopt it."

The Heilmann locomotive has already been described and illustrated at various times in The Electrical Engineer.

CAR HEATING.

Through an inadvertence the concluding paragraphs of Mr. George B. Damon's article on "Car Heating" were omitted in our last issue. Mr. Damon now concludes as follows:

When we consider that air is heated by contact with surfaces that have absorbed heat and not by radiation, as heat will pass through gases without perceptible loss, the advantage of double windows in closed cars becomes apparent.

Experience has proved that with double windows and an air space of about 4 inches between the surfaces of the glass panes, one square foot of glass will cool about .5 cubic foot of air as many degrees per minute as the temperature inside the room exceeds the temperature outside. That means in the case we have considered that about .5 of the coal needs to be burned to accomplish the same results.

A system operating 100 cars would save 11,250 pounds of coal a day if the cars were provided with double windows and under the conditions outlined. Outside of that the power station equipment would be reduced correspondingly and the size of the heaters cut down one-half. The equipment of cars with double windows is reduced to a commercial question which each street railway manager can quickly decide for himself.

LIVE STOCK BY TROLLEY IN IOWA.

A special dispatch from Mason City, Ia., says: J. G. Lindon, the big stockman of this part of the State, has shipped to the Eastern markets 88 steers by way of Mason City & Clear Lakes Electric Railroad, which extends some seventeen miles between the two places. Near Mr. Lindon's town farm are the electric railroad's stockyards, which have been fitted up for handling the business of this kind for this section of country. Mr. Lindon and other large dealers now ship all their stock this way, and are finding it very satisfactory.

Such is the success of the freight and passenger business of this electric railroad, which has been in operation only since last August, that many places through this part of the country are agitating the matter of building similar lines. It is proposed to build northwest from here through Fertile to Lake Mills, also southeast through Coldwater to Rockford. A similar line is planned from Charles City to Hampton, and from Clear Lake to Belmont.

THE TROLLEY IN EGYPT.

A trolley line in Egypt seems somewhat of an anomaly, nevertheless both Cairo and Alexandria are equipped with up-to-date street car lines. The one in Alexandria, which also goes to the town of Mex, was formally opened on the 11th of September last, in the presence of the Khedive and his court, his royal highness riding next the motorman on the first car to go over the line. On the following day the line was thrown open to the public and over 8,000 people took advantage of the opportunity to ride on the strange new cars. The rolling stock at present consists of ten automobile cars, each equipped with two 25 h. p. Walker street car motors, and the power house contains two 125 k. w. d. c. Walker railway generators. The reports of the trial published in the French papers declare it to have been most successful.

TROLLEY TRACKS are now being built on the Brooklyn Bridge.

SOCIETY & CLUB NOTES

ELECTRICITY DIRECT FROM HEAT. BEFORE THE BOSTON "ELECTRIC POTENTIALS."

THE first dinner of the season held by the members of the Boston "Electrical Potentials" took place at the Hotel Thorndike on Friday evening and was well attended by members and friends. At the close of the dinner Colonel E. H. Hewins, president of the club, submitted the names of five gentlemen seeking admission to the "Potentials." These were unanimously elected, after which Mr. Frank Ridlon, ex-president, delivered a brief and feeling eulogy on the late G. W. ("Happy") Adams, who recently passed away.

They had all known "Happy" Adams, who was the same genial, kind-hearted and sympathetic friend at all times. Since his death he (the speaker) had been going over Mr. Adams' affairs for the family and what had impressed him most of all were the many evidences left behind of unknown generous deeds done from time to time for friends and acquaintances. "Happy" had his faults and weaknesses like other men, but he was possessed of a very warm heart; the world was the better for the lives of such men, and he had gone to his reward.

Captain W. Brophy followed with a few expressions of kindly remembrance for the genial friend who had recently joined the "silent majority."

Mr. H. Barringer Cox, of London, the guest of the evening, then gave an outline of his now well known work in inventing practical thermopiles. It had been a long struggle with him, but he considered that he had at last succeeded in placing on the market an efficient thermopile that was not destined to supresede all existing systems, but was easily available for installation in private houses, etc., for various purposes.

He claimed that his device of 1 h. p. capacity would furnish current sufficient for ten 16 c. p. lamps to cost only 1 cent per hour; in other words, that each lamp would cost only 1-10 of 1 cent per hour. He would not undertake to build a machine of larger capacity than 250 lamps, but such a machine, operated by furnace heat, would be much more economical than existing plants of like capacity. Mr. Cox was able to impress his hearers thoroughly with the value of his invention, explaining that owing to his factory having recently been completely burned out, he was at present quite unable to fill his orders, he having no less than 5,000 machines on order, with capacity for building only a few hundred a week.

Many forceful questions were subsequently asked the speaker, who was quite ready with straight replies. The company then carefully examined the thermopiles, which, by means of gas jets, were operating fans, telegraph sounders, spark coils and gongs. After a cordial note of thanks to Mr. Cox, the meeting adjourned.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. G. F. Porter, secretary of the Association, informs us that President Insull has issued a call for a special meeting of the executive committee to be held on Monday evening, November 22, at the Holland House, Fifth avenue and Thirtieth street, New York. Matters of very considerable importance to the association will be taken up at that time and a full meeting of the committee is looked for.

NEW YORK ELECTRICAL SOCIETY, 183d MEETING.

The 183d meeting of the society will be held in Room 301, Engineering Building of Columbia University, West 116th street and Western Boulevard, on Monday, Nov. 30, at 8 P. M. The president, Dr. M. I. Pupin, will explain the scope of the programme arranged for the season, and give an informal address on "The Physics of Ether." Downtown members will find it convenient either to take the Boulevard car all the way, which will land them at the University gates, or the elevated to Sixty-third street or 104th street station and thence by car.

MEETING OF CREDIT ASSOCIATIONS.

A meeting was held in the Astor House, this city, on Nov. 11, of the electrical trade credit associations of New York, Philadelphia, Chicago, Cincinnati and Boston, all of which sent delegates. A very interesting and useful meeting was held. Resolutions were passed to form a national credit association, and a committee was appointed to draft a constitution for such a society. The work of the local bodies in raising the general level of credits in the trade, and in protecting manufacturers against bad debts, has been of a most striking and encouraging character; and there is reason to believe that the opportunities are large for the usefulness of a similar national body, embracing all the centers of supply and distribution. The New York local association will hold its annual meeting on Dec. 7, at the Astor House.

LEGAL NOTES

RIGHT OF WAY FOR TROLLEY ROADS IN WISCONSIN.

A SUIT brought some months ago by James Rouen of the town of Oak Creek against the Milwaukee, Racine & Kenosha R. R. Co., for the recovery of $5,000 damages alleged to have been done his property by the building of the line in the road abutting his property, was decided on November 6 in favor of Mr. Rouen, who was awarded 6 cents damages. The result of this suit has been watched with a great deal of interest. It was a test case to the extent of deciding for the first time in the State the amount of damages to which property owners were entitled by the building of such a line in the public highway.

This suit was the outcome of the crossing war at South Milwaukee between the Milwaukee, Racine & Kenosha Railroad and the Chicago & Northwestern Railroad, the latter refusing its permission to the Racine road to cross its tracks because it had not secured a right of way by condemnation proceedings, as provided in the case of the building of railways intended for freight as well as passenger transportation.

The Supreme Court held that a road running through the country and carrying freight, as this road was authorized to do, was something more than a street railway, and added, possibly, a burden to the people out of whose land the highways were carved which the ordinary use would not impose upon them. It was at the same time held to be necessary to provide for damages, where damages were incurred of that nature. The Legislature promptly passed an act that the damages should be appraised the same as in the case of an ordinary railroad, to remove the stain of unconstitutionality. An application was therefore made to appraise the damages done to Mr. Rouen, and the commissioners for that purpose were appointed.

Vice-President A. W. Bishop, of the Milwaukee, Racine & Kenosha Railroad Company, said that his company considered the suit a test case. Mr. Rouen's farm is a large one, and is situated on both sides of the road, about a mile and a half south of South Milwaukee. The commissioners, Charles Merrill, B. Held and T. Morrissey, met upon the premises to determine the amount of damages to which Rouen might be entitled. They awarded him the 6 cents.

IS SALE OF CURRENT BY ISOLATED PLANTS ILLEGAL? AN INTERESTING PITTSBURG CASE.

THE Allegheny County Light Company, of Pittsburg, Pa., has brought action against I. Jackson & Bros., the clothiers of that city, to show cause by what right they furnish electric light to persons outside their building. The case promises to develop into one of the most important legal proceedings that has been instituted for a long time. The appeal was made by W. B. Rodgers, attorney for the Light Company, to Attorney General McCormick, and a writ of quo warranto asked for.

The case grows out of an ordinance which has been pending in councils for some time past, which will compel all persons crossing a street with electric wires to first take out a permit from the Bureau of Highways, and have the work done under the direction of an inspector to be appointed by the city. Attorney General McCormick has fixed November 16 for a hearing in the case.

Mr. R. Jackson, of the firm says: "On the first of September we placed in our basement a complete electric light plant, with a capacity of 2,000 lights, which costs us $450 a month to maintain. Our establishment only requires about 800 lights, so we decided to sell the remainder of our power to neighbors. From this source we receive an income of about one-third of the cost of maintenance, or enough to pay the fuel.

"In running the wires to the places of business of our customers we complied with all the provisions of the ordinance then in effect. We do not claim to have a company capitalized

to supply electric light, but we do pay a State tax upon our general business, a part of which is our electric light plant. We also pay a county tax upon our building and a special county tax upon our light plant. In addition to this we pay our city tax, and I think that is all that should be required of us.

"In putting in our wires we complied with all of the conditions provided by the Board of Underwriters so far as isolation and precaution from danger to life or property is concerned.

"If the city desires an inspector to look at the work we shall not object in the least. But we do claim the right to supply electric lights the same as the Allegheny County Light Company or any other concern, and we propose to make a fight for what we consider our rights."

An official of the Allegheny Company says: "The Allegheny Electric Light Company is a chartered organization, and we are after only those people who are supplying electric light without a charter. The Tradesmen's National Bank, for instance, supplies light to a large number of people nearby, but they first organized a company giving them authority to do so, under the name of the Etna Electric Light Company. We have nothing to complain against competition of this kind. On the other hand, the First National Bank is also supplying light to outside parties, and we propose to attack their charter on the strength of this. Their charter empowers them to conduct a general banking business, but does not empower them to sell electric light. We will try to make them give up one or the other unless they take out separate charters.

"These individual manufacturers are really taking the right of eminent domain, without any power whatever to do so. We not only have a charter from the State, but are compelled to apply to the city every time that we place a wire underground, and furnish the proper officials with blue prints, showing the exact location of the wires that we are putting in, and the pipes that we will go near, neither of which the others do.

"There is a large expense connected with all this, and, if individuals are allowed to sell light without having to go to this expense, then we want the same right. We are also compelled to pay taxes to the State upon our capital stock, our bonds and on our gross earnings."

THE STOCK MARKET

A STRONGER TONE.

During the past week the stock market conditions improved materially, and it is said in some quarters that the recent "bear" reaction is at an end. It was a week of eddies, but the current at the close was flowing strongly toward higher prices. There was no genuine Cuban scare in Wall street; it was pretty nearly all "fake." All the trade conditions of the country are better, and the consumption of iron and steel is enormous. The status of the railroads may be inferred from the fact that while in the September quarter last year the New York Central had about $40,000 surplus earnings above its fixed charges and dividend, this year the surplus amount in the same quarter was $701,000. St. Paul for the first week in November showed a gain in gross of $143,000 over the same week in 1896. Such figures there is no getting away from.

On sales of 16,919 shares Western Union advanced to 86¾, a net gain of 1¼. On 6,785 shares General Electric advanced to 33¼, a gain of more than $3 per share. New York Edison is firm at 121 and rising. In Boston, American Bell Telephone on small sales stood around 252½. The market for local lighting and street railway securities throughout the country is good, a great many properties of this character reporting solid net gains.

Prices for copper are 10.87½, a slight decline, said to be due to the engineering strike in England. Heavy steel rails are quoted at $19.50.

THE THIRD RAIL.—A party of officials from the motive power department of the Pennsylvania Railroad inspected the third rail electric system of the "Consolidated" road last week. They were met at New Haven by General Superintendent C. H. Pratt, John Henny, superintendent of motive power, and Colonel N. H. Heft, chief of the electrical department. Superintendent Davidson of the Hartford division joined the party, and the third rail lines between this city and New Britain and between New Britain and Berlin were gone over and tests of speed were made. The power plant at Berlin was also inspected.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOVEMBER 9, 1897.

Alarms and Signals:—

ELECTRICAL INSTRUMENT. W. C. Banks, New York, 593,187. Filed March 12, 1897. Automatic resistance device for block signal circuits.

SIGNALING SYSTEM. C. B. Sterling, New York, 593,314. Filed Feb. 25, 1897. Means whereby a plurality of alarms may be sounded simultaneously from one point.

LOCK CIRCUIT CLOSER. C. E. Pierce, New York, 593,335. Filed July 2, 1896. Comprises an electric alarm operated by the lock bolt.

AUTOMATIC BLOCK SIGNAL. J. M. Williams, T. P. Kinney, Danville, and H. W. Kinney, Lynchburg, Va., 593,504. Filed May 28, 1897. Details of construction.

Batteries, Primary:—

BATTERY CUP. J. A. Britton, Phillipsburg, N. J., 593,193. Filed Nov. 7, 1896. Embodies a cup provided with a textile bottom for containing the zinc in gravity batteries.

BATTERY ZINC. D. Ogden, Columbus, Ind., 593,332. Filed Dec. 24, 1896. Means carried by the electrode for interlocking with a similar electrode, and means whereby both may be independently held in a cell, one beneath the other.

Conductors, Conduits and Insulators:—

INSULATING JOINT. W. H. Lau and P. A. Bredsvold, Chicago, Ill., 593,381. Filed Feb. 12, 1897. Designed for gas piping.

JOINT OR COUPLING FOR ELECTRIC CABLES. G. Tailleur, Chicago, Ill., 593,442. Filed July 31, 1897. Comprises interlocking terminals, insulating sleeves connected to the conductors and having opposing flanged ends and a two-part coupling engaging the flanged ends of the sleeves and serving to hold the terminals and the sleeves together.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. C. F. Scott, Pittsburg, Pa., 593,244. Filed Jan. 12, 1895. Comprises an alternating-current generator, and a step-up transformer interposed in the circuit approximately midway between the generator and translating devices for raising the e. m. f. to maximum limit at the generator.

Dynamos and Motors:—

APPARATUS FOR ASSEMBLING COMMUTATOR BARS. S. H. Short, Cleveland, O., 593,282. Filed April 26, 1897. Comprises a diagonally-split and compressible spring strap in which the commutator bars are assembled radially, a casting arranged to receive the split ring, and means for contracting the strap within the casting.

CONSTRUCTION OF END RINGS FOR COMMUTATORS. S. H. Short, Cleveland, O., 593,283. Filed May 3, 1897. Comprises a continuous end ring built up of strips of insulation, each strip successively shaped to conform to the commutator-bars.

CONSTANT CURRENT DYNAMO. C. N. Black, New Haven, Conn., 593,388. Filed Feb. 1, 1897. An open coil, constant current dynamo, having the terminals of its individual bobbins or sets of connected bobbins connected to segments, of different commutator rings.

Miscellaneous:—

DEVICE FOR OPENING ELEVATOR DOORS. J. Rice, Chicago, Ill., 593,434. Filed Nov. 2, 1896. Details of construction.

ELECTRIC CONTROLLER. J. H. Bowley, Washington, D. C., 593,510. Filed Feb. 24, 1897. Means for controlling and operating the valves and appliances employed to regulate the atmospheric conditions of food storage rooms.

PROCESS OF TREATING METAL STRUCTURES. F. Shuman, Philadelphia, Pa., 593,440. Filed Sept. 17, 1896. Process of electroplating structural ironwork with copper.

Railways and Appliances:—

TROLLEY. E. Lane and J. A. Snyder, Johnstown, Pa., 593,301. Filed April 24, 1897. Of a construction adapted to dispense with reversing the trolley at the end of the line.

PUSH BAR FOR TROLLEY CARS. W. H. Thomas, Lahaska, Pa., 593,340. Filed June 24, 1897. Comprises a push bar provided with forked ears and rectangular parallel ears provided with an orifice, and a removable coupling pin.

RETURN WIRE CONNECTION FOR ELECTRIC RAILWAYS. J. H. Bickford, Salem, Mass., 593,369. Filed March 15, 1897. Comprises a cable separated and having several strands leading to each rail and solid ends connecting the strands to the rails.

ELECTRICALLY ACTUATED SWITCH MECHANISM. W. S. Brown, Brooklyn, N. Y., 593,389. Filed June 8, 1897. A railway switch operated by electromagnets, under control of the motorman.

TROLLEY POLE AND STAND. F. A. Seaver, Hartford, Conn., 593,424. Filed March 29, 1897. The pole is formed by toggle arms pivotally connected with each other.

Switches, Cut-Outs, Etc:—

MAGNETIC CIRCUIT BREAKER. D. McF. Moore, Newark, N. J., 592,230. Filed June 24, 1896. Embodies a vibrating part in magnetic equipoise, and means for intermittently moving it.

ELECTRIC SWITCH FOR CHANDELIERS OR BRACKETS. J. W. Parkin, Philadelphia, Pa., 593,237. Filed Jan. 26, 1897. Details of construction.

ELECTRIC SWITCH. H. E. Waite, New York, 593,286. Filed May 28, 1897. Designed for cutting in and out any number of cells in a therapeutic apparatus.

AUTOMATIC CIRCUIT BREAKER. W. B. Lowrie, Newark, N. J., 593,481. Filed April 24, 1897. Means for magnetically short-circuiting the magnetic field employed to keep the circuit closed when the current exceeds any desired limit of strength.

Telegraphs:—

APPARATUS FOR PARTY TELEPHONE LINES. C. E. Scribner, Chicago, Ill., 593,245. Filed March 16, 1897. Device to obviate interference in operation between the different parts of the system.

TELEPHONE TRANSMITTER. J. W. Thomson, Bedford, Ind., 593,255. Filed March 1, 1897. Comprises a diaphragm carrying a cell containing resistance-varying material and two electrodes, one fixed in relation to the diaphragm, the other loosely suspended in the midst of the granules.

TELEPHONE SYSTEM. W. W. Dean, St. Louis, Mo., 593,372. Filed July 12, 1897. Adapted for use in connection with party telephone lines.

MULTIPLE SWITCHBOARD SYSTEM. F. C. Hughes and G. W. Kelley, Detroit, Mich., 593,394. Filed Feb. 1, 1892. Details of construction.

TIP FOR TELEPHONE CORDS. J. W. Gottschalk, Philadelphia, Pa., 593,467. Filed Oct. 6, 1897. Consists of a pin and a clamp having a perforated end slipped over the pin, with means for holding the clamp onto the electrical conductors.

TRADE NOTES & NOVELTIES

THE BULKLEY INJECTOR CONDENSER WITH AIR PUMP.

In our last issue we illustrated and described the Bulkley injector-condenser which has been introduced in a large number of electric light and power stations. In this issue we present the Bulkley injector-condenser connected with air pump. The accompanying engraving shows the usual connections, but they may be arranged to suit the requirements of each case.

The exhaust steam is condensed within a cone of moving water, and imparts to it a velocity which expels the air and vapor through the "neck," into the suction opening of the pump. The momentum of the water is thus used to materially assist the pump by reducing its load, and a high vacuum is maintained by the combined action of the pump and the injector.

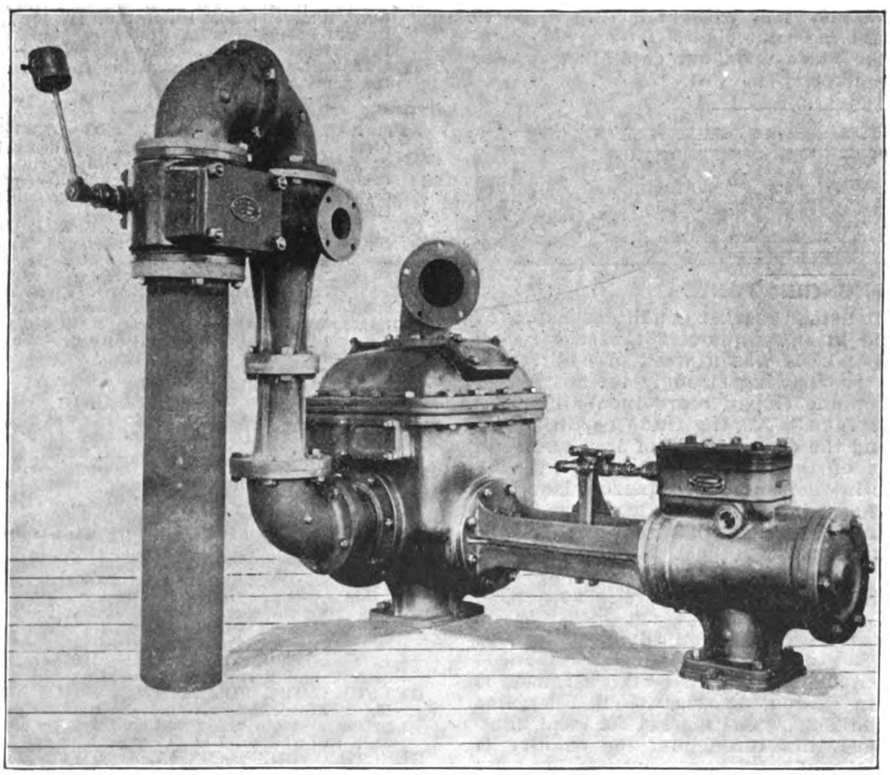
The steam cylinder has an improved positive valve motion, and the pump is of the best construction, having brass lining, brass piston and valve seats, with ample valve area. A duplex pump, having an outside valve adjustment, is furnished with the condenser, if preferred, in place of the pump illustrated.

This condenser will form a vacuum before the engine is started, and the speed of the pump can be adjusted to the load on the engine, or to the temperature of the condensing water. An automatic relief valve of special design, is furnished when desired, to operate when the condenser is not in use.

A special feature is the Bulkley patent Safety Device, which is placed in the exhaust pipe, between the engine and the condenser. It consists of a cup shaped valve with guiding spindles, balanced above its seat by means of the rock shaft, levers and weight in the position shown.

It will be seen that any backward movement of the water from the condenser, is directed into the cup-valve by the inlet nozzle above, and will instantly close it, thus effectually sealing the entrance to the engine cylinder. In this way absolute safety is insured, without the use of floats, air valves, check valves, etc., required with other condensers.

This apparatus is manufactured by Henry W. Bulkley, 225 Broadway, New York.



THE BULKLEY INJECTOR-CONDENSER CONNECTED WITH AIR PUMP.

GROWTH OF THE ENCLOSED ARC INDUSTRY.

The Electric Arc Light Co., of 687 Broadway, New York City, has sent us the following under date of Nov. 10:

Few appreciate the actual cost of introducing successfully on the market an article embodying a new principle. In most cases the cost of selling is found to exceed the cost of manufacturing the article. The liberal policy of the Pioneer people has proven such to be their case in the past in forcing to the front and making a place in the electrical field for the enclosed arc lamp, and even at the old price of $30 they found the margin of profit small.

This preliminary work they consider has now been done, and the enclosed arc lamp is recognized to-day as the only lamp considered in arc lamp work, and the business has grown to such magnitude that the Electric Arc Light Co. early in the season took steps to enlarge their manufacturing plant, and they are pleased to announce that this plant is now completed, with a capacity of 1,000 lamps per month, and with the new facilities thus secured, and with the large amount of business they are doing, they are enabled to effect a saving which it is their purpose to give to the consumer and announce a reduction in price of their Standard brass lamp from $30 each to $25 each.

We are sure that this liberal policy will be responded to by the trade and still further add to the call on the Electric Arc Light Co. for Pioneer lamps, and while they have always claimed this lamp to be the most perfect piece of mechanism in the market, the price has been placed at the same point by them as makers of lamps which they claim have had less experience, and who are in reality infringers on the broad

basic patents of Marks, and now that the commercial position of the Pioneer lamp is assured, it is understood that the owners of the Marks patents are beginning a most vigorous crusade against all infringers, which covers all types of enclosed arc lamps except such made by manufacturers as may have been licensed.

COLUMBIA RAILWAY LAMP.

THE Columbia Incandescent Lamp Company, of St. Louis, is making a very superior lamp for street railway service, cut of which we present herewith. It will be seen that the filament, instead of being anchored, is made with a two-and-a-half turn coil, which will readily withstand the vibration in car service, and does away with the necessity of the anchor, which has been found objectionable on account of the fact that the filament is often broken at the point where the anchor is made.

It is claimed that by the process employed in the manufacture of the filament used in these lamps the Columbia Company is able to produce lamps of absolute uniformity in respect to current consumption, which insures an even distribution of light in the cars. The lamps taking the same amount of current when burning in series will burn at the same incandescence.

Columbia Railway Lamp.

The lamps are in use on a number of the large street railway systems throughout the country and are giving most excellent satisfaction.

VETTER ELECTRO MEDICAL SPECIALTIES.

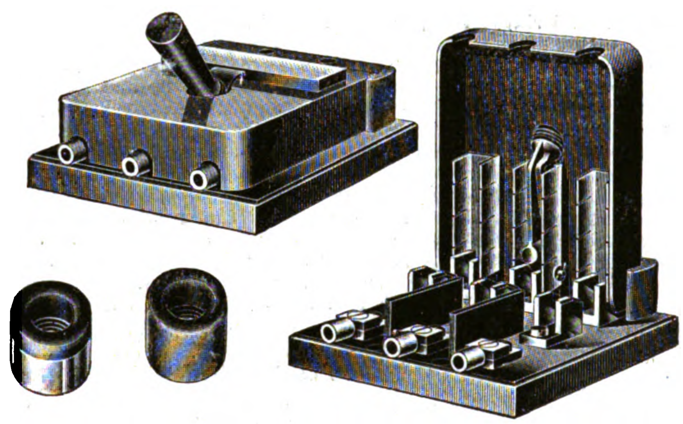
Mr. E. B. Meyrowitz, 103 East Twenty-third street, has issued the following notice to the trade: "I take the liberty to inform you that the firm of J. C. Vetter & Co., of which I was a partner, has dissolved by limitation. The business will be continued hereafter as the Electro-Medical Department of E. B. Meyrowitz, and will be in charge of Mr. A. F. Vetter, the inventor and designer of the various improvements which have made the "Vetter Electro-Medical Apparatus" the recognized standard apparatus in the practice of electro-therapy. It will be my aim to place at the disposal of my patrons in this department the best and most improved devices in the scientific application of electricity in electro-medicine, and I most respectfully solicit your continued favors."

ANDERSON SWITCH AND INSULATOR SPECIALTIES.

WE illustrate herewith the service switch and Ætna outlet insulators made by the Albert & J. M. Anderson Manufacturing Company, of 289 A street, Boston. The three-pole quick-break switch, Fig. 1, is provided with fuse terminals and screens, as shown, and is designed for use as a cut-out where the wires of the lighting company enter the building.

When closed, as shown in Fig. 2, the entire switch with fuses is covered by an insulating cover of Ætna material. If the lighting company desires to discontinue the supply of current to a customer, provision is made so that after removing the fuses the closed switch may be sealed up with the company's seal, and current cannot be taken except by breaking the seal. Careful attention has been given to good material, workmanship, and contact. The action of the switch is positive, the construction simple, and the insulation, being of "Ætna," is of assured efficiency.

The Anderson outlet insulators are used at the free ends of iron interior conduit to protect the wires from contact with the end of the pipe and from chafing. They also add a neat finish to the end of the pipe.



Figs. 1, 2 and 3.—Anderson Service Switch and Outlet Insulators.

With regard to their Ætna and Hecla insulation the firm say: "During our eight years' experience in the manufacture of Ætna insulators we have furnished nearly all the larger and very many of the small electric railways with Ætna insulators. This long test has proved them uniformly reliable and durable in a remarkable degree. For high insulation, great strength and weather-proof qualities they have an international reputation.

"Absolutely no expense has been spared that could improve their quality. Equipped with this successful experience in manufacturing railway insulators and a full complement of special machinery, dies, tools, etc., for pressing up the compound, we have for a long time past experimented with a view to producing an insulating material made up of less costly ingredients than used in the Ætna, but by a similar process and with equal care. The result of this experimenting is the Hecla insulating compound, which, after the most exhaustive tests for insulation and strength, we are now prepared to place upon the market at very reasonable prices and to guarantee. It is less expensive than many other compounds, and thoroughly reliable. The Hecla brand of railway insulation, made up with some of the same forms as used with the Ætna, and some new forms, is bound to give a degree of satisfactory service unattainable with other and less carefully made material. A trial is solicited."

MICA.

Eugene Munsell & Co., and the Mica Insulator Co., of 218 Water street, New York, and 117-119 Lake street, Chicago, announce that they carry at all times a large stock of their "three great lines of insulation," "Mica," "Micanite," and "M. I. C. Compound," and are in a position to supply at short notice special forms of insulation for any system of electrical apparatus. They make a specialty of the prompt filling of orders, both from their stocks at New York and Chicago, as well as at their local agencies in the following cities: Cuyahoga

Supply Co., Cleveland, O.; Arthur S. Partridge, St. Louis, Mo.; Sinclair Randall, Cincinnati, O.; Brooks-Follis Electric Co., San Francisco, Cal. M. I. C. Compound is their latest production, and is commanding considerable attention among the electrical trade.

SOLDERING IRON OF AMERICAN ELECTRICAL HEATER COMPANY.

WE illustrate herewith one of the various forms of soldering irons made by the American Electric Heater Co., of Detroit, Mich. They make several sizes, ranging from 1 pound 6 ounces to 4 pounds 4 ounces. The style shown herewith is their No. 3, which weighs 2 pounds 8 ounces. A great

SOLDERING IRON OF AMERICAN ELECTRICAL HEATER COMPANY.

use has been found for these irons, not only in electrical lamp factories, but by tool makers, type foundries, glass workers and others. The company are equally successful with their pressing irons, of which they make several varieties, employed by merchant tailors, dry goods merchants, leather and fur dealers, etc. Mr. Scranton, of the American Electric Heater Co., reports the demand as excellent.

KERITE NOT IN THE PROPOSED TRUST.

Mr. W. R. Brixey, the proprietor of the well known Kerite brands of insulation, has written to the papers as follows: "In your issue of yesterday there is an article headed "Proposed Wire Trust," and among the companies named is the Kerite Company. I am the sole owner of the Kerite factory, and wish to deny that I am a mover in any such enterprise. I am the only individual owner of any of the factories mentioned in the article, manufacturing rubber insulated wires and cables, and know of no reason why I should sacrifice a business which has been established since 1860. If any of the other companies named are in such straits as to require them to form a trust to monopolize the market the same should not be attributed to me. I always have been and am still prepared to carry out the contracts which I undertake without the assistance of my competitors."

PICTURES OF THE C & C DYNAMO.

Some very attractive panel cards are being issued by the C & C Electric Co., of New York, and their appearance is such as to insure their escape from the usually open-mouthed waste basket. Their presence upon the walls of an engineering office assists in producing the desired professional appearance therein, and engineers who have not already received them should write for them. Those so far sent out show the latest type of C & C multipolar dynamos of the belted and direct connected types, but the company is now preparing to send out others illustrating their other types of machines. The C & C Company report a continued active demand for their new types of ironclad enclosed and ventilated motors and their slow speed multipolar generators.

ILLINOIS TELEPHONE SUPPLY CO., 340 Dearborn street, Chicago, have just gotten out a new wall circular illustrating over 100 kinds of telephones and parts, with net prices attached. It will be sent free to any address on application.

ADVERTISERS' HINTS

ALFRED DOLGE & SON, 110-112 East 13th street, New York, supply wool felts for all purposes.

THE WARD LEONARD ELECTRIC CO., Bronxville, N. Y., illustrate the type of their "Universal" automatic starting box installed in connection with the motors at the Mergenthaler Linotype Co.'s works, Brooklyn, N. Y., a detailed description of which appears in this issue.

THE WHEELER REFLECTOR CO., Boston, Mass., remind central station managers of the approaching holiday season and the consequent special lighting of stores and show windows. Of this they have made a study and they are in a position to aid customers in securing the best results.

THE D. & W. FUSE CO., 53 Aborn street, Providence, R. I., say it is far better to protect circuits with their non-arcing fuses than to stand the trouble and expense of burn-outs.

THE HART & HEGEMAN MFG. CO., Hartford, Conn., have something to say about good things, but it goes without saying that their switches may be included under that head.

THE CALIFORNIA ASPHALT CO., 57 East Fifty-ninth street, New York, advertise the Alcatraz electrical compound for insulating and waterproofing and claim that it is not affected by acids and alkalies.

THE ANCHOR ELECTRIC CO., 71 Federal street, Boston, Mass., might publish a sermon on the force of gentleness with the easy operation of their push buttons for a text.

THE BOILER EXPURGATOR CO., 115 Dearborn street, Chicago, Ill., will send with every order for a dozen sticks of Holm's Tesoline commutator compound a free copy of the Dynamo Tender's Handbook, by F. B. Badt. This offer is limited to Jan. 1, 1898.

SOME EXTRAORDINARY CLAIMS are made for a new interior conduit, which we are told is coming. A tube which is fireproof and waterproof ought to cut a wide swath.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

VOL. XXIV. NOVEMBER 25, 1897. No. 499.

TELEPHONY AND TELEGRAPHY

THE GROWTH OF THE "PRIVATE BRANCH TELEPHONE EXCHANGE" SERVICE IN NEW YORK CITY—AN INTERESTING EVOLUTION.

PROBABLY the attention of more than one of our readers has been arrested by the recent change in the numbering of the telephone call of some of the large concerns or corporations with which they do business. Not long ago, it was an ordinary thing to see in the telephone directory a long string of numbers against any one important name, and there would often be hesitation as to which should be selected. Now, however, against the name of the General Electric Co., for example, appears one number only, with the note "Private Branch Exchange connecting all officers and departments," which means that on calling up the number, you are immediately switched by the intelligent operator on to the circuit of the person you wish to reach. The Western Electric Co. has the same notation. Under "Cortdt. 4901. N. Y. Journal," you read as follows: "Any departments of the Morning, Evening and Sunday Editions or Das Morgen Journal, may be called on this number." Such legends are simply the earmarks and indices of a great change which within the current year has swept over the telephone business in New York City and has done more than any other thing to reduce the "Busy Report" to a minimum and a mere thing of shreds and patches as compared with the congested condition of affairs before the solution of the problem in the shape of the Private Branch Exchange system came into the field. About a year has gone by since this device or development was first experimented with. At the beginning of 1897, some 32 of these exchanges were in tentative existence. There are already 150 of such exchanges in active operation, enabling nearly 1,400 separate interior stations to reach each other in their own groups as well as the outside world, with the utmost ease, dispatch and economy. It is needless to say that this evolution of the telephone art has had to meet many new conditions and is being watched or patterned after all over the country. Indeed its adoption by steamship companies on this side of the Atlantic has led to a desire for duplication of the same methods and arrangements on the other side, so that as the big grayhound slips out of the telephone circuits here as a last severance from the shore so the first thing on her arrival across the herring pond is to plug into the board that opens up at once direct speech with the steamship company's departments there and all the great world outside. This may not be "international brotherhood," but it comes fairly near a transatlantic unification not only of language, but of the means of intercommunication by word of mouth, in spite of 3,000 miles of ocean intervening.

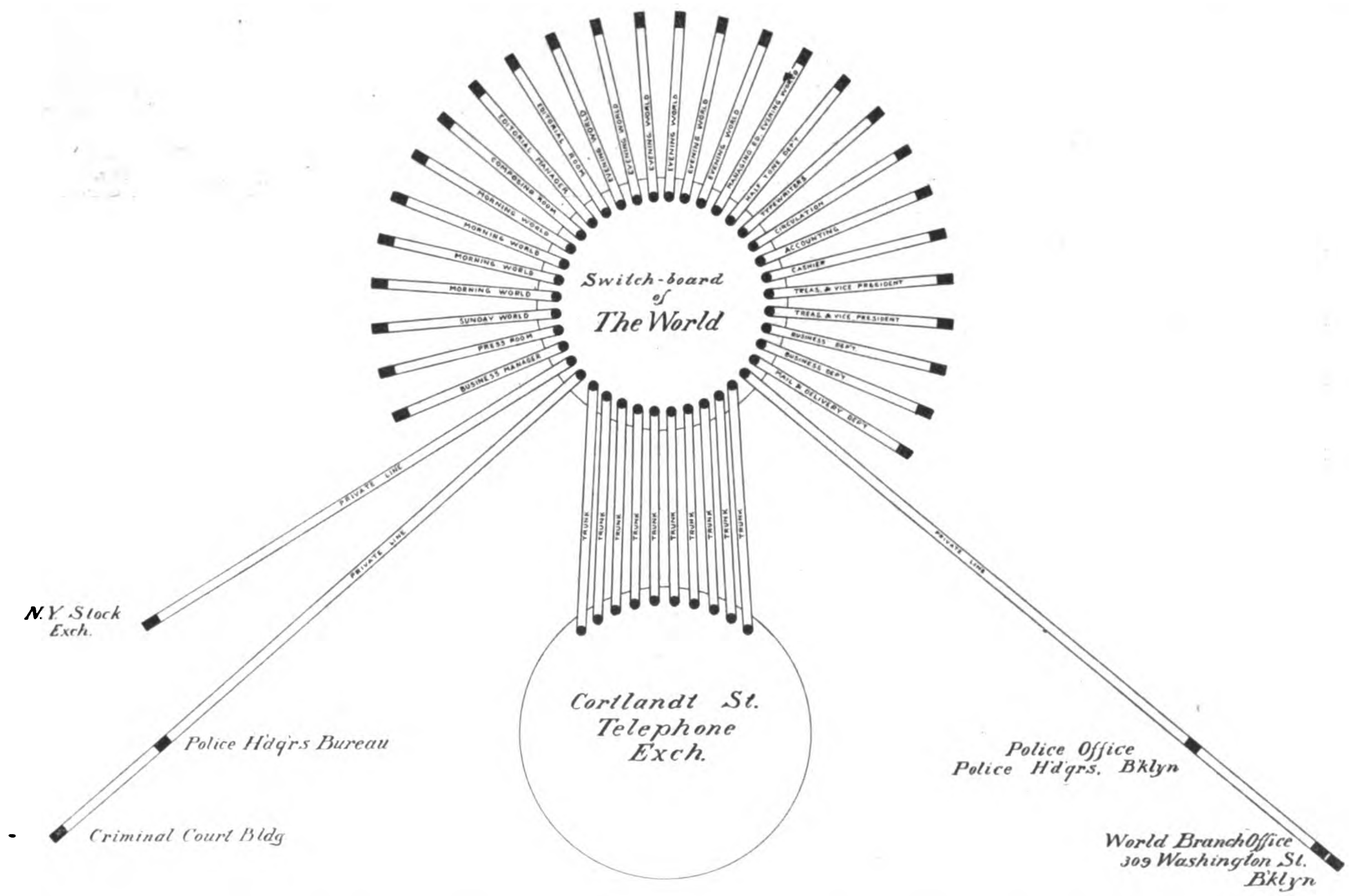


FIG. 1.—DIAGRAM ILLUSTRATIVE OF THE PRIVATE BRANCH EXCHANGE OF THE NEW YORK WORLD AND ITS CONNECTION INTO THE SYSTEM OF THE NEW YORK TELEPHONE CO.

To return to the local service and conditions in New York City, the first question that will arise is that of price, and it is at this very point that the wisdom of the New York Telephone Company in putting into force a lowpriced message rate becomes apparent. In fact, without such a schedule, it is doubtful whether the idea could have been developed at all. The private branch exchanges vary in magnitude and activity, but every grade is treated on its own basis, so that

the old "flat rate" disappears entirely before the method of paying simply for just what you get. We give below the company's private branch exchange schedule:

Switchboard; for 1 to 20 lines	$24.00	per annum
" " 21 to 40 lines	36.00	"
" " 41 to 60 lines	48.00	"
" " 61 to 80 lines	60.00	"
Operating Station	24.00	"
Each line to the Central Office	36.00	"
Each station on the premises and connecting with the local switchboard	24.00	"
4,000 local messages	165.00	"

Additional stations elsewhere than on same premises and connecting with the local switchboard (each) $24.00 per annum, plus a mileage charge for the line between the station and the switchboard at the rate of $20.00 per annum per quarter mile or fraction thereof.

Additional local messages .... $3.00 per 100

Messages not contracted for in advance........5 cents each.

Contracts for Branch Exchange service will not be made for a less amount than $333.00, nor for a less period than one year.

Newspaper offices furnish, perhaps, as good an idea as any place of the scope of the work possible with this innovation, and we illustrate herewith diagrammatically the service furnished to the New York "World." This paper has a switchboard "central," the board being equipped with ten pairs of cords; and also has 27 extension instruments scattered throughout the various offices of the paper, giving a very complete private line equipment. The central board has head and hand receivers, and is attended by three operators relieving each other at 9 A. M., 5 P. M. and 1 A. M., so that there is always a skilled person in charge. As the diagram shows, in addition to the interior intercomunicating system, there are ten trunks to the New York Telephone Company's central exchange, so that a "busy report" becomes unknown and literally impossible, with infinite gain to the paper at moments of great rush and urgency. There are also three private lines as follows: No. 1 to the "World" Brooklyn Branch taking in the business office, editorial rooms and police headquarters; No. 2 to the Criminal Courts Building and Police Headquarters Bureau, and No. 3 to the New York Stock Exchange. So far as we are aware, no record is kept of the calls within the

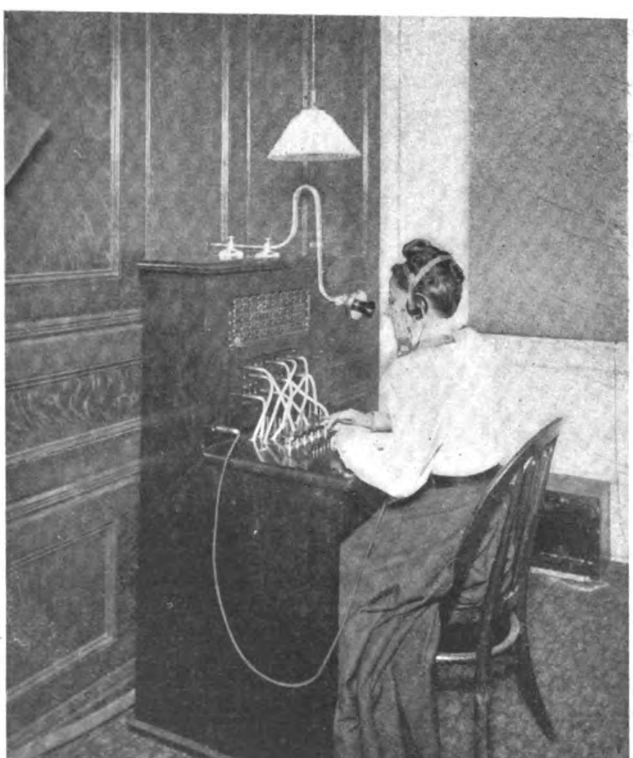


Fig. 2.—Branch Telephone Exchange at the H. B. Claflin Co., New York.

"private" circle, but it is a fact that they are incessant, and the board becomes a very lively clearing house for a large proportion of the office work. As to the messages going outside either over the "World's' own lines, or through the regular exchange, it is said that the reporters rarely go to the office except for their assignments, and transact a very large proportion of their business with their chief over the telephone. Mr. Golding, the "World" Purchasing Agent, who has charge

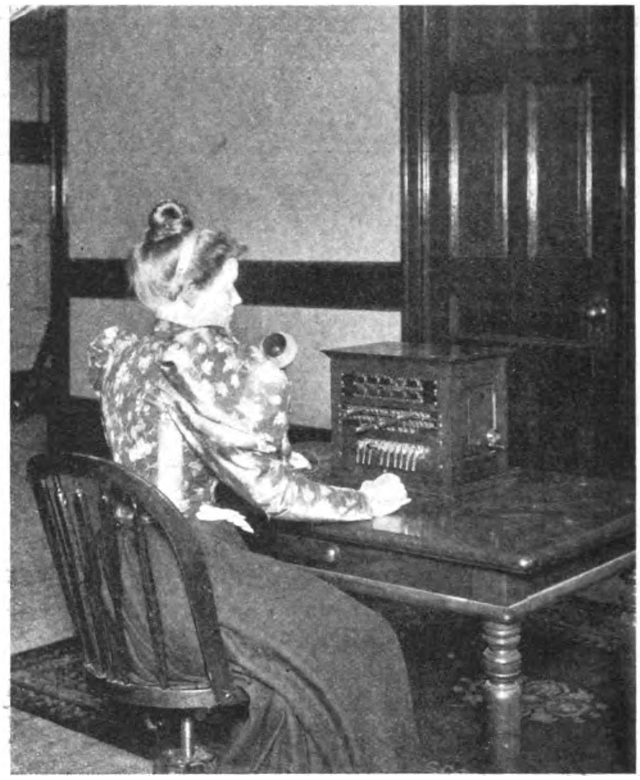


Fig. 3.—Branch Exchange for Office with Group of Ten Instruments or Less.

of the telephone department, is keenly appreciative of the value of the system.

An interesting feature of the new development is the demand it has created for good operators at good pay in desirable positions. In the "World" office, the young ladies are all old Cortlandt street exchange operators, who understand the system thoroughly and experience no difficulty in obtaining the desired connections for the callers. As they are acquainted with the various departments and officials of the "World" office, they are able to refer the business direct to its right channel, and this not only simplifies telephoning within the office, but relieves the New York Telephone Company's central of much delay and uncertainty. It is a curious fact that the introduction of these Private Branches has, while cutting down the "Busy Report," made the parties owning these little exchanges far more patient and tolerant of apparent slowness in getting a connection. They can and do see for themselves, under their own roof, how it is, and why persons cannot always be got five seconds before they are wanted. Of course, something depends on the provision of a proper number of trunk lines between the branch and "central"; and given that number a subscriber operating a branch will never be bothered by the holding up of incoming calls. Under the old system of a single trunk, the congestion was often most exasperating, simply and solely because the line could not accommodate the traffic. Incidentally it may be noted that a concern equipped in this way with manifold lines and a Private Exchange stands by that evidence alone as an important business enterprise, and to that extent is distinguished among its fellows.

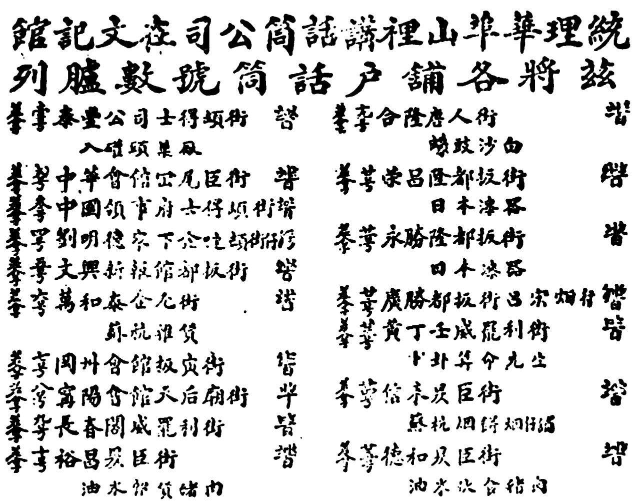
These 150 Branch Exchanges vary, of course, in size. It will have been noted that the schedule of rates endeavors to meet these gradations of service. One of our illustrations shows the exchange at H. B. Chaflin Company's, where the young lady is kept busy all day long with the telephone work of that vast dry goods emporium, and where the exchange is a thing apart like the counting room or the electric light plant. On the other hand, where facilities not so extensive are needed, an equipment to take care of ten lines or less is provided, as shown in Fig. 3. Here the box board is mounted on any large table at which the operator can sit and perform typewriting or other clerical work in the intervals of her at-

tendance on calls at the board. It is found that the combination works out admirably.

We may add by way of conclusion that since investigating this system with an idea of telling what it amounted to, we have been permitted to see a large number of technical reports on the service by the New York Telephone Company's officials, and a big batch of letters from the concerns using the system. It is very evident from these outspoken testimonials that a great deal of satisfaction is being derived and there are further indications that concerns which ramify into other cities are bringing their telephone business elsewhere into a conformity with that here, so that with the intervention of the long distance lines the speediness of the service will be as great as though the two persons, separated perhaps hundreds of miles, were talking from desk to desk in one office.

TELEPHONY IN OUR LEADING CHINESE CITY.

ONE hears a good deal about Chinese competition, and just now miners in Illinois are agitated over reports that thousands of Chinamen are to be introduced into the collieries there, crowding out white rivals. There are, however, some circumstances under which it is imperative to resort to Chinese labor and skill, and this is the case in the establishment of a Chinatown telephone exchange in our leading Chinese city, San Francisco. The Pacific Telephone Co. found that such a service was desirable and necessary, and President Sabin has therefore carried out the scheme in a regular, matter-of-fact way. We reproduce herewith portion of a page from the Chinese section of the San Francisco Telephone directory, but may explain for the benefit of the curious, who



PART OF PAGE IN CHINESE TELEPHONE DIRECTORY, SAN FRANCISCO.

wonder how the average man would be able to call up these Chinese subscribers that a translation of the list appears handily adjacent in the book.

It must not be supposed that the telephone girl is a dainty Chinawoman on tiny feet and in beflowered silks. She is a man. His name is very appropriately Ching Soy Sing, and he is proud of his priority as the first Chinese "opellata" in the country, perhaps in all the world. He has a high position in Chinatown as manipulator of the "walking voice," and necessarily considers himself under great responsibilities. There are 34 subscribers to the new exchange under his care, all of them Mongolian merchants or men in the professions practiced by Chinamen in this country. They do not hesitate to use their telephones freely, and it is said the language goes very well over the line, owing to the high pitch of the average Chinese voice. When Mr. Sing cannot give prompt connection he says: "Choy Que Ko," which being interpreted, means "Line busy; call again." Mr. Sing is also a master of pigeon English, so that he is able to put his subscribers in communication with those who speak only the plain American tongue. It seems likely that now the step has been taken, the exchange will grow and more operators will be required.

MR. A. L. CHAMBERLAIN, of Lowell, Mass., writes: "Enclosed please find $3 for renewal for your valuable paper—to say nothing about the data sheets."

MISCELLANEOUS

AMERICAN ELECTRICAL WORK IN EUROPE.[1]

BY ROBERT P. PORTER.

IN visiting twenty-five of the leading European cities last summer, it was a matter of gratification to find how rapidly American electrical engineering is pushing its way, not only in England, but in every direction on the Continent. In London, Dublin, Cork, Bristol, Coventry, Paris, Berlin, Hamburg, Brussels, Aix-la-Chapelle, Dresden, Vienna and as far southeast as Budapest I found American electrical engineering had been practically adopted for the street car systems. In fact, wherever a community was breaking away from omnibuses, or those nightmares of street transportation, the hideous steam tram cars, there I could easily discern the ingenious hand of American enterprise. Nay, more than this, for as a rule, I met in charge of these works either our own countrymen, or foreign engineers who had spent years in the United States in our great electrical establishments. In addition to the transportation interests, there are three other distinct lines of electrical industry in which we may safely be said to lead if the expert statistics count for anything. First, mining appliances, which include pumps, locomotives, hoists, blower and kindred devices; second, appliances for the transmission of power, including the alternating current system, dynamos, transformers for producing high or low voltage and other power machinery, and third, telephone, counting and electric light appliances. The field for this sort of enterprise is practically unlimited, and it would be hazardous to attempt a forecast of what it may become within the next twenty-five years. Europe is only just beginning to sample the advantages of the electric street car, and the light railway propelled by electricity. Of the 7,500 miles of tramways in all Europe, including European Russia and Turkey, and of nearly 10,000 miles of track, not much over 2,000 miles in 1896 were electrical. It is certain that horses, steam and cable grips must go and in their place will come electricity and compressed air. America leads in both these branches of industry and in all methods of street transportation. To merely supply the necessary change of motor power for Europe, we have a mileage equal to half the electric mileage of the United States. This, however, gives but a meager idea of the possibilities, because Europe, with a population of 300,000,000, will not long be content with half the miles of street railways which we have in the United States to serve a population of 72,000,000. There is not only a field here awaiting American enterprise, but also capable of great expansion if properly worked.

In a recent and very interesting article on the large exports of electrical appliances the New York "Journal of Commerce" calls attention to the imperfect classification of the Bureau of Statistics in relation to electrical machinery and appliances of all sorts. It is difficult, as matters now stand, to give complete statistics on the subject, though a better classification, I believe, is promised for the year 1898. The only heading under which comparisons can be made with exports during recent years is that of "Instruments and apparatus for scientific purposes, including telegraph, telephone and other electric" supplies. These figures show total exports valued at $324,600 for July (the latest detailed statement issued by the Bureau of Statistics), which, however, indicates an increase of $143,144 from the July, 1896, record, while for the seven months ending with July the value of the exports reached a total of $2,043,802, representing an increase of $480,909 over the corresponding period of last year. Following are the figures for the seven months, showing the countries to which the supplies were shipped:

United Kingdom	$264,096
France	178,835
Germany	186,325
Other Europe	210,185
British North America	200,934
Central America and British Honduras	63,606
Mexico	190,155
West Indies and Bermuda	77,727
Argentina	107,409
Brazil	81,954

[1]Abstract.

Other South American	97,550
China	6,235
Japan	101,924
British Australia	48,591
Other Asia and Oceanica	50,219
Africa	177,943
Other countries	114
Total	$2,043,802

Among the items not included in the foregoing table is the important item of electrical machinery. Prior to July, 1897, the Bureau of Statistics did not state these articles separately; they have now decided to do so.

This is a matter to rejoice over, because we shall soon be able to watch with accuracy the extension of American electrical engineering in its broadest sense into the markets of the world.

Before referring to some specific instances of important American achievements, it may be well to call attention to some facts in relation to the growth of electrical undertakings in the United Kingdom, bearing in mind the fact that so far England and her possessions are our greatest customers in this particular line of manufacture. The bearing of this must not be underestimated, because if we can thus in part supply the British market, it would indicate that we have a fair chance to compete with out greatest engineering rivals for the other markets of the world. Indeed, the fact may be said to have already been recognized and the superiority of our workmanship attested by expert English authority. The "Engineer," of London, for instance, says:

"We have gone to the United States to get elevators for the Central Railway of London, and now we have to look to the same side of the Atlantic for the electric plant with which this traffic is to be worked. We are unable properly to equip an electrically worked tramway, and until our manufacturers take the trouble to teach their hands how to provide new machinery, the large and increasing contracts for this industry must be given to Americans."

Such comment as this, though made in that peculiar, carping spirit which Mr. John Bull assumes when obliged to admit American superiority of workmanship in anything, should nevertheless encourage those interested in American electrical enterprise. They should take heart and push the harder, and win for this country not only the reputation for the most ingenious appliances, but the best made also. The quality of the English-made articles has been such an old song and dance of the British competitor, that people have come to believe it long after it has been put on the shelf with other figments of imagination as old fiction. England, of late years has taken up the electrical industries vigorously, and in 1896 her electrical undertakings may be thus stated:

	Nominal Share Capital.	Companies. Subscribed Shares.	Capital Debentures.
Telegraph	$126,484,400	$114,898,535	$22,290,160
Telephone	30,175,000	24,203,920	8,211,020
Electrical Supply	27,717,500	19,996,085	6,580,015
Electric Traction	54,494,150	25,520,990	2,282,605
Manufacturing	41,233,190	25,884,245	6,449,900
Miscellaneous	24,666,625	12,674,410	1,318,715
Total	$304,770,865	$223,173,185	$47,132,415

	Municipalities. Loans Authorized.
Electrical Supply	$9,339,910

While England is in fairly good position to supply telegraph and lighting enterprise, those who know most about the state of the enterprise, admit that she is behind the United States and even the Continent in ability to meet the demands where electricity has been applied to what they call their tramways. In America and on the Continent of Europe, English authorities admit there has been during the last few years a general movement in the direction of substituting electrical power for horses, and there are many indications that England is now following the lead of other countries in this respect. There are at present about 100 miles of electrical railways and tramways in operation in the United Kingdom. The first of these, the Portrush to Giant's Causeway line (eight miles), was opened as long back as 1883, and the more important of the others are:

Bessbrook and Newry Tramways, opened 1895, 3¼ miles.
Blackpool Tramways, opened 1886, 2¾ miles.
City and South London Railway, opened 1890, 3¼ miles.
Guernsey Tramways, opened 1891, 2¾ miles.
Leeds Tramway, opened 1891, 3¾ miles.
Liverpool Overhead Railway, opened 1893, 6⅛ miles.
South Staffordshire Tramways, opened 1893, 7¾ miles.
Douglas-Laxey Tramways, opened 1894, 7 miles.
Bristol Kingswood Tramways, opened 1895, 4¼ miles.
Snaefell Mountain Railway, opened 1895, 4¼ miles.
Coventry Tramways, opened 1895, 5¾ miles.
Dublin Southern Tramways, opened 1895, 8 miles.
Hartlepools Tramways, opened 1896, 2½ miles.

This is not a record which will admit of comparison with the nearly 14,000 miles of electrical street railways in the United States, or with the progress of electric traction in many of the continental countries; but the fact that there are now in England about 200 miles of electrical tramways and railways projected, and partly under construction, besides others in contemplation, shows, even to the British mind, that a recognition of the advantages of electric traction is not longer confined to foreign countries. Nearly all of this has been contributed by American firms. An American firm recently secured the contract for the Central London Underground Railway, one of the most unique enterprises of the times. Some of the electrical tramways about to be constructed are lines previously worked by steam or horses, while many of them are extensions of existing tramways and new lines in districts not hitherto served by tramways.

Those engaged in the manufacture of street railway supplies will see from the following quotation from an English electrical authority that the Briton has at last awakened to the importance of this branch as a British industry:

"Considering that during the past six years tramways of all kinds in the United Kingdom have increased by only about 50 miles, the new developments must be regarded as considerable; nevertheless, the experience of other countries and tramway statistics generally—indicating, as they do, a very wide scope for the application of electricity—enable us to look upon the new electrical enterprises referred to as merely the inauguration in this country of the general adoption of this form of traction. The law in regard to the promotion and working of tramways in this country has lately been modified in a way facilitating the use of electric power."

Last August, when in Liverpool, the Town Council had up for discussion the inauguration of electric motor power for the recently municipally acquired city tramways, the chairman of the committee, a man familiar with the condition of the American electrical industry, proposed a well known American electrical engineer to take charge of the work. The highly intelligent and unprejudiced Town Council entered objection on the ground that England should be able to furnish its own experts for such undertakings. The proposition was turned down. Subsequently, the chairman of the committee, who knew what he was about, resigned. Then a compromise was effected and it was decided that a British engineer should be in charge, but the American should be employed as "consulting engineer." But it takes two to make a bargain, and the American engineer declined to act. That is the last I heard of the incident, but it all points to the fact that our kin across the sea do not intend to let us have a walkover in this, our strongest line of engineering. Still, we are in the field now firmly, and with courage and enterprise, there is no reason why we should not continue to occupy the first position in all matters electrical. There are great opportunities for us, not only in England, but all over the world, for the new century will inaugurate the age of electricity, and the nation of its birth and first utilization should rightly hold first place in all appertaining thereto.

THE TESTING OF INDIA RUBBER GOODS.

We have on more than one occasion been approached by buyers of India rubber goods with queries as to some method of ascertaining the quality, even approximately, of their purchases. Something besides chemical analysis is wanted, they say, as such analyses are not only apt to be expensive, but in many cases they do not indicate the presence of any latent evil, such as errors in mixing the materials or in vulcanization. Such faulty workmanship is apt, when the goods are in use, to show itself in an undesirable way, and consequently to lead to passages of arms between buyer and seller, a condition of things to be avoided in the interests of both parties. It is the wholesale buyer who more often finds himself in difficulties in this way, because, although he can generally by strong representation get the goods complained of replaced by the manufacturer, yet such replacement does not obliterate the effects of the evil, as loss of trade resulting from a bad name is not regained all at once. Another great drawback to chemical analysis is that the goods have to be cut up, or, at any rate, cut into, at some point or other to obtain material for the analyst to work upon, and in many cases it means a serious loss to do this. Again, the cutting up of one article of comparatively small value does not conclusively show that the figures obtained from its analysis

apply to the whole delivery of which it is a unit, such is the variation that is so commonly found in deliveries of rubber goods. Thus chemical analysis, on the whole, seems out of the question, and it therefore remains to be seen how far physical tests can be adapted so as to give a fair criterion of the quality of the goods and of their suitability for the purposes for which they are intended, while at the same time no damage is done to the articles by the test so as to unfit them for sale. To mention some specific cases. It may or may not be matter of common knowledge that the majority of our leading railway companies submit all deliveries of carriage and wagon buffers to severe mechanical tests, and such as fail to reach a certain standard are rejected. It should be mentioned that such tests are only insisted on by those companies who pay a fair price, and expect to get sound rubber.

At the present time there are great variations in the prices paid by railway companies for goods intended for the same purpose, three times as much being paid in some cases as in others. We doubt the policy of buying cheap and nasty mechanical rubber, but in the light of what has occurred in other branches of the rubber trade, it is gratifying to find that the railway companies who buy such goods do not expressly stipulate that they shall stand the tests usually applied to the best quality. This testing of buffers on a large scale of course takes time, and involves, in addition, the purchase of rather expensive machinery; but there is no doubt that it pays the buyer. Without going into great detail, it may be said that the buffer testing machine is on the principle of the ore stamp, five or six hammers being worked by a cranked axle, and striking blows on as many buffers. The superficial dimensions of the buffer springs are carefully measured before and after the test, which may consist of from 1,000 to 10,000 blows, and may last a whole day. A good buffer should measure the same after as before the test, though one of inferior quality, i. e., wanting in elasticity or badly vulcanized, will be found to have sustained a permanent set after the test. It will be seen at once that this test is of more value than any chemical one would be, and it puts the rubber manufacturer on his mettle, as it is no easy task to get such an equality of vulcanization as is required to conform to the standard of this test. We have known of cases where half a delivery has been returned as unsuitable, though to the best of the rubber manufacturer's knowledge the material and the method of manufacture was similar throughout. We rather suspect that variations occur in the rubber which are not to be detected unless by some such severe test as the one under notice, and which could hardly be discovered in the unvulcanized rubber, though this is a technical matter which does not directly concern us at the present moment. It is necessary to add, however, that whether owing to this inequality in the elasticity or lasting power of rubber buffers, or to other causes, there seems to be a decided revulsion of feeling in favor of steel springs for rolling stock at the present time, and it behooves the rubber manufacturers to look to their guns unless they wish to lose a considerable business. We append here some figures obtained by a railway company from a delivery of buffers all supposed to be of equal quality, and they show decidedly that some variation either in the quality of the rubber or in the method of manufacture has occurred:

	Loss after Plates. Percent.	Loss after 10,000 Machine Blows. Per cent.
1	nil	50
2	"	39
3	"	19
4	"	25
5	"	10
1	2	48
2	8	43
3	17	36
4	7	45

The loss after plates, it should be said, refers to the permanent decrease in thickness noticed after the buffers have been screwed up under pressure for a length of time between iron plates, and the percentage of loss refers to the decrease in lifting power or elasticity. For example, a buffer which will lift a weight of 6 tons before undergoing the machine blows and only 3 tons afterward shows a loss of 50 per cent. It is rather exceptional for a delivery of buffers to show such great variations as are given in the table, but the figures show the value of the test from the railway engineer's point of view. Other railway goods, such as vacuum diaphragms, hot water hose, etc., cannot be easily tested, though a system of testing high pressure steam tubing by attaching two or three lengths to steam jets, and comparing their behavior under pressure, has been adopted with good results, as indicating the temperature and pressure the hose is capable of standing without injury. Leaving the railway companies, we may glance at some points in the specifications sent out by the admiralty, who are large buyers of rubber goods, and for whose contracts there is considerable competition. The rubber has to be supplied in the form of vulcanized sheets and it is cut into valves, washers, etc., as required at the various dockyards. Three qualities of rubber are bought, and the exact amount of rubber, mineral and sulphur they are to contain is specified, any variation from the figures given rendering the contractor liable to have the goods thrown back on his hands, a contingency which it is unnecessary to say involves him in considerable loss. The testing employed seems to be almost entirely chemical, and the strictness with which the authorities visit any variation from the limits of sulphur laid down in the specification is carried to a degree which we venture to say is hardly warranted. The idea of a low limit of sulphur is, we suppose, that the goods are less liable to deteriorate when in use by reason of oxidation of uncombined sulphur, but it must not be overlooked that a low content of sulphur necessitates a prolonged vulcanization, and it is extremely doubtful, to say the least of it, whether this prolonged heating is better for the rubber than would be the presence of say an extra one-half per cent. of sulphur, which would tend to shorten the time of vulcanizing.

Some few years ago Lieutenant Vladimiroff, of the Russian navy, made a series of experiments to establish the testing of rubber goods on a sound and satisfactory basis, the following being the main conclusions at which he arrived. It will be seen that the tests advocated are physical ones, as he came to the conclusion that chemical testing gave no reliable results.

1. India rubber should not give the slightest sign of superficial cracks on being bent to an angle of 180 degs. after five hours' exposure in a closed air bath to a temperature of 125 degs. C. The test pieces should be about 6 centimeters thick.
2. Rubber containing not more than 50 per cent. by weight of metallic oxides should stretch to five times its length without breaking.
3. Pure caoutchouc free from all foreign matter, except the sulphur necessary for its vulcanization, should stretch seven times its length without breaking.
4. The extension measured immediately after rupture should not exceed 12 per cent. of the original length of the test piece. The test pieces should be from 3 to 12 millimeters wide and not more than 6 millimeters thick and 3 centimeters long.
5. The percentage of ash gives a certain indication of the degree of softness, and may form a basis for the choice between different qualities for certain purposes.

Any excess of sulphur over that required for vulcanization should be removed at the works, and should not appear on the surface of any object.

Now these tests on the whole seem very well calculated to give useful indication to engineers as to the quality of the goods they are buying, only we would interpolate here the remark that unless a good price is paid for the rubber, it is no use submitting it to such physical tests as these. India rubber substitutes made from oil, and "recovered rubbers," i. e., old rubber worked up again with oil, have nothing like the elasticity appertaining to new sound rubber, and they are quite incapable of standing the elongation or heat tests mentioned. The concluding remark of the Lieutenant is somewhat naive, and though no doubt it expresses a desirable consummation, we may perhaps be permitted to ask how it is to be effected. No doubt the excess of sulphur over and above that required for vulcanization should be removed, but how is it to be done? In the case of thin goods, consisting of rubber and sulphur only, it is possible, and, indeed, is the regular practice, to remove the excess of sulphur by boiling in a solution of caustic soda, but this could not be done in the case of valves or buffers over an inch thick. Of course the alternative to this is the English Admiralty low limit of sulphur, but, as we have already said, we are not particularly enamored of this, and do not feel inclined to recommend its more general inclusion in rubber specifications.

The specific gravity of a rubber compound, or what comes to the same thing, the number of cubic inches to the pound, is very generally taken by buyers as a correct index of the value, though in reality such is often very far from being the case. In the rubber works the qualities of the rubber made vary from floating, the best quality, to densities corresponding to 11 or 12 cubic inches to the pound, the latter densities being in demand nowadays by many consumers with whom price appears to be the main consideration. It will be obvious that such densities as these can only be obtained by utilizing to the utmost the quality that rubber exhibits of taking up a large bulk of added matters.

In Lancashire a common test of mechanical rubber is to

throw it into the millpond to ascertain its floating power or otherwise. Of course it is all right as discriminating between a floating and a compounded rubber, but the mere fact of a rubber floating does not show that it is necessarily of a good or elastic quality, because it must be remembered that there may be a large amount of extraneous organic matters present in the form of oil substitutes which are of practically the same density as rubber. By such a test a compound containing a considerable quantity of substitute is found superior to one consisting of the best rubber and 20 per cent. of zinc oxide, a conclusion which would not by any means be borne out in practice. We therefore hold out a word of warning to buyers of rubber goods not to set too much store by this gravity test, as it may very often afford an incorrect criterion of value, though at the same time it is difficult to suggest an alternative test of equal simplicity, or one that does so little damage to the goods. It is, of course, apparent that rubber containing 10 or 70 per cent. of mineral will sink equally in water, and it is useful to extend the test by employing solutions of common salt or chloride of calcium which a rubber of approved density will float in, and samples can be compared with this as a standard at any time. Space prevents our going further into this matter of rubber testing, and we shall conclude with the observation that on the whole what the Russian authority says about the inadequacy of chemical analysis is well founded, and it behooves engineers to work out special mechanical tests easy of application which may serve to convince them that what they are buying is—to use a borrowed expression—of the nature, substance and quality demanded.—Engineering.

DEFECTS IN ELECTRICAL SPECIALTY DESIGNING.

BY H. N. GARDNER.

WHAT is more provoking to a workman of any kind than to attempt to use an appliance supposed to be made for some particular purpose, only to find that through imperfect design or workmanship the article is not suited for the purpose at all? Particularly is such an occurrence aggravating if the workman happens to be away from the shop with no tools to remedy the defect without going back and wasting considerable valuable time.

It is doubtful if there is any class of work where such aggravations are more frequently met with than in electrical work; for it is also doubtful if any class of manufactured articles contain more weak points and inconsistencies than many of the electrical specialties that are now being turned out.

The main object of many manufacturers of this line of goods seems to be to turn out an article that they can sell because it is cheap, never thinking that by dispensing with the services of a competent designer and hiring cheap, inexperienced help to put it together after it is designed, they are turning out an article which they can sell for 5 cents less than their competitor sells his goods, but that the workman who installs the appliance will waste 25 cents worth of time in getting it to work in the unsatisfactory manner in which it must always remain. The fault cannot be said to be wholly with the manufacturer of the goods, however; for as long as construction companies will continue to buy the articles because they are cheaper in first cost, just so long will such articles continue to be manufactured.

A few of the defects recently observed in connection with some of the ordinary appliances used in electric light wiring can easily be enumerated. Most of these defects could easily be remedied by the manufacturers, if they would devote a little more attention to the manner in which the goods are manufactured, as well as to their sale after being imperfectly constructed. The corrections could, in most cases, be made without the articles costing any more for their manufacture. There is probably no electric wireman who is at all observing but could add considerably to the list without going far back in his experiences.

One of the most frequent exasperations met with by wiremen is the imperfect selection of screws by the manufacturer, with which to equip the appliance. Especially is this true in connection with branch and main blocks, switches and other such articles. How much profanity has been traceable to the fact that such articles were found at the last moment to contain screws too short to answer the required purpose, when brass screws a sixteenth of an inch longer would cost but a trifle more a gross?

A main block was recently noticed that was stamped thirty amperes. No intelligent electrician would think of trusting it to carry over half of that amount of current for any length of time; but that was what the manufacturer called it good for. According to the underwriters' rules, which the manufacturer was supposed to observe, no smaller than No. 6 should be used to conduct 30 amperes of current. In the particular case where the block was to be used it would seldom happen that over 3 or 4 amperes would be required, and 15 was the maximum that could be taken. Nevertheless, a No. 6 wire had been used. But when it was connected to the main block it was found that such short binding screws had been put into the block that they would not reach across the wire until the washers with them had been removed, and then they would hold for only one or two threads. There was plenty of room in the porcelain vase, however, to have permitted of using a screw an eighth of an inch longer.

Screws are sometimes found that are too long. But it is easier to cut one off than it is to lengthen it, unless it happens to be like another case recently observed in which screws were placed in such a position that it was impossible to get them out to even cut them off. This was in a three-point flush switch manufactured by a well known specialty house; and for a combination of exasperating defects and fool designing these switches must be admitted to go ahead of anything that it has been the writer's misfortune to run across.

Not only were the binding screws in the switch terminals twice as long as was required, but the terminals had been tapped in such a position—before the switch was put together, of course—that the screw heads were directly in line with parts of the next terminals, and so close to them that the screws could neither be removed, nor was it possible to get at them in any manner with a screwdriver. After nearly an hour had been wasted, and the points of two knives broken in unscrewing, connecting and screwing up again, it was found on turning on the current that the screws were so long that the switch blade came in contact with them, causing a momentary short circuit every time it was turned. Not only did the screw heads short circuit the switch, but the terminal contacts themselves were so long that they caused a momentary short circuit with every turn.

It did not seem possible that any shop could manufacture an article without mechanics with enough common sense to notice some of the defects in the switch; and it is certain that the switches were never any of them tested at the shops, or all of the defects would have been easily discernible. While the firm may have been able to sell the goods cheaply, it is certain that no intelligent buyer would ever make a second purchase of them. This was not a single one of the lot that has been taken as an example, but all of that make of switches so far seen have the same defects.

It frequently happens that branch and main blocks have to be placed in rather small boxes at centers of distribution. How many wiremen have had difficulty, when doing this work, in having the terminal binding screws of the blocks, part or all of them on the sides so that it was almost, or quite, impossible to get at them with a screw driver in the close confines of the box? A little experience in the block designer and foresight in designing would easily remedy this defect; for it would be possible without any extra cost to so send out the terminals that all of the binding screws would face out.

Some three-point switches of another make were recently installed, every one of which had to be taken apart and the ends of the terminals filed off in order that, in turning, a momentary short circuit might not result.

The sockets made by one of the best known manufacturers, and a firm that has the reputation of putting out as good wares as any in the market, could be made a little safer if they would form the porcelain base and the shell so that the small screws that bind the shell to its base did not come exactly opposite the terminal binding posts, making it very easy for any careless workman to bend the wire or leave the end too long so that it is easy for the shell to be thrown in contact with the conducting wire. While this mistake should not be made with the present form of socket, it could not, if the design was changed in this particular, which would not increase the cost of manufacture or decrease the ease of connecting.

Many rosette ears and their binding screws are so formed that unless the greatest care is exercised in connecting them there is danger of cutting the wires while doing that work. Other rosette ears are so placed that they come almost, or quite, in contact with the ceiling, thus making of little effect the careful removal of the insulated wire in all other points. Such rosettes have been noticed on stamped steel ceilings where the distance between the live ear and the grounded metal was not over a sixteenth of an inch, but the insulated wire had been securely removed at least an inch from all grounded metal in other places.

Switch and rosette bases and other porcelain parts that have

to be screwed to the wall are frequently formed with such small holes for fastening screws that no regular stock screw can be found that is small enough and at the same time long enough to reach through the porcelain and the thick plaster.

Fixtures are also frequent examples of poor designing from the electrical point of view, and in a manner in which it would be just as easy to make them without the defects. Some combination fixtures are so made that there is no opportunity to run the wires between the casing and gas pipe without cutting out parts of the fancy ring work in a manner that disfigures the whole fixture. In some cases the casing cup at the place where the wires have to be soldered at the branching out for the individual lights are so small that it is almost impossible to get the soldered joints into them, when a larger cup would be fully as ornamental, and would cost little more.

Other fixtures have the arms for the individual lights of such a shape, or the holes insufficiently drilled out, that it is extremely difficult to get the wires through them at all, when fully as graceful turns could be given to them, at the same time avoiding all of this difficulty.

So the enumeration of such defects in manufacture or design might be continued. Most of these evils could be avoided if the manufacturers would give more care to the designing, or would hire men to do this work who have had actual experience in performing the work for which the appliance is intended, whether they are fully entitled to write "E. E." after their names or not, or whether or not they can as well calculate the impedance of an alternating current. If the man's knowledge permits him to do these things as well as to tell whether it would be possible to drive a screw with a screwdriver, so much the better, but have some one that can tell about the screwdriving at any rate. If the designing work does not require the services of such a man all the time, there are plenty of practical men to whom the article can be submitted, who can assist in pointing out the defects and suggest improvements.

Another thing that all manufacturers should do, but which the products of their factories prove is frequently left undone, is to submit every article after it is manufactured in exactly the size and shape in which it will be put on the market, to all of the tests to which it will be subjected in actual use, and the size and shape of no part should afterward be changed without again testing it, for a very slight change may frequently cause a short circuit or other equally grave defect.

MODEL TANK AND ELECTRICITY AT WASHINGTON NAVY YARD.

BY JAMES EUSTIS PRICE.

AFTER much investigating, planning and delay, Uncle Sam has at last begun an important work, which in Europe has been for years in practical operation. This work concerns the testing of the speed of models, upon the lines and comparative dimensions of which ships will be constructed.

At present, as is well known, the speed of a ship cannot be accurately estimated until the vessel is finished, put to sea and driven "for all she is worth" by experts, who know how to get out of her the last fraction of a knot of which she is capable, and incidentally to get out of the government the extra cash these "last fractions" call for. In this matter the builders are simply doing their duty according to law and agreement. But the government intends to save the greater part of this speed money by calculating beforehand as near as possible by model, the actual speed of the craft, which the former represents. Hence the experimental tank now under construction at the Washington Navy Yard.

The site of the tank is near the river (the Eastern branch of the Potomac), not far from the great gunshop. Up to date the foundation for the building, which is to cover the tank, is only partly completed. This is built upon piling driven into the soft clayey soil, and bristles with bolt rods, by which the base of the arching walls of the building will be secured. When finished the structure will be 500 feet long by 45 feet wide, and with its great area of water (to be 14 feet deep) will present somewhat the appearance of a huge indoor bathing place. But the latter effect will be very much lessened by the humming of machinery and the rattle of wheels as the models of future ships dash through the miniature sea.

Around the inner walls of the experimental tank, and several feet above the water, a track will be laid, running perfectly straight until the ends of the building are reached; here a curved recess is formed, and in this the models are started. On the track will be four electric motors, geared after the manner of those used on electric street cars. These will work in pairs, being connected by a transverse shaft extending from side to side of the tank and carrying at its centre a depending lever, to which the model will be attached. Thus when the motor carriages are in motion the little ships will be towed along at a speed corresponding to that of the tower, and the force exerted will be measured by a dynamometer, secured at the lower portion of the carriage.

Although two sets of motor carriages are to be used in making speed tests in the tank, one set is to be employed as an auxiliary power for higher speeds. The maximum motor force will be about 100 h. p., derived from an electric plant to be built especially for the experiment work. The models are to be made 20 feet long, a size much larger than any heretofore employed in experimental work of this kind. They will be of many different kinds, and their testing will no doubt give much useful knowledge to those concerned in naval architecture. Of course there is no such thing as establishing by model tests absolute certainty in regard to the speed and behavior of a ship at sea; but by getting the difference in force exerted upon a model and that expended in driving a ship built after such model the speed of the latter must at least nearly correspond in ratio to its full-size representative. One thing is certain, that if the "model" idea is correct it will be an easy matter to choose by experiment the best of their kind much more so than to begin and end the experiment in the ship, which does not always prove a greyhound of the deep.

The experimental tank when finished will represent a considerable amount of government money. One hundred thousand dollars have already been appropriated for the building, tank, etc. But by the time everything is ready for operation the sum named will be generously increased.

The employment of electricity as a working force at the Washington Navy Yard is becoming more apparent as time goes on, and it is probable that the not very distant future will see the vast aggregation of machinery there moved by this convenient power. At present five 208 h. p. boilers, using 10 tons of coal per day, furnish steam power to the greater portion of the machinery. The huge lathes in the immense gunshop, throughout which guns of all sizes and in all stages of construction are strewn—the cranes (of 110, 40 and 15 tons lifting capacities, respectively) and all other machines in this busy department are worked by steam.

But, though steam is king at the yard, electricity has found a foothold there. It is used in the foundry, principally, in connection with three cranes employed there for lifting heavy weights; it is also used for crane work in the breech mechanism shop. The whole machinery system of the latter place can at any time, at short notice, change its power from steam to electricity. The electric plant consists of nine dynamos, which, besides supplying power for machinery, furnish currents for 1,000 lights, when all the latter are in use, but only about one-half of this number are usually employed.

There are a great many of these lights in the gunshop, and when night work is to be done on the "nation's defenders" the scene in the brilliantly lighted cannon factory is worth beholding. From end to end of the large shop (225 feet long by 138 feet wide) guns—some of them over 50 feet in length—are reflecting the light from their coats of glittering steel, in some cases turning slowly on lathes; while the trimming tool cuts off shavings of tough metal, the boring tool winds in the guncore, or while the polishing process adds new lustre at every turn of the lathe.

The gunshop is a wonderful place, as is the whole Navy Yard, with its splendid equipment, for helping Uncle Sam to get ready for his war business, if things should look up in that line.

ELECTROLYTIC COPPER PRODUCTION IN RUSSIA.

Dr. Rostin writes in "Elektrochemische Zeitschrift," Vol. IV., No. 6, concerning the status of electro-metallurgy in Russia: The first works in which electrolysis was applied was that of Messrs. Siemens & Halske, at Kedabeg, in the Caucasus. Later, Nikolajev established works at Nijni-Novgorod, and recently Rosenkranz has made an installation at St. Petersburg. Nikolajev began operation seven yeasr ago, and at present is producing about 15,000 poods of electrolytic copper a year, 1,500 poods of tin (recovered from tinplate scrap), 2,500 poods of antimony, 1,500 poods of white lead and 6,000 poods of various by-products, among the last being pure nickel, which is obtained by a private method from nickel-iron. In the copper department there are 70 vats arranged in cascade form. The process employed has certain novel features which have been developed in these works. The volume of current employed is generally 40 amperes per square meter. A tenor of 0.003 per cent. of gold or 0.1 per cent. of silver in the material treated is said to cover the entire cost of the electrolysis. Such material is very frequently obtained, especially from the Caucasus and Verkhne-Isetsk.

Besides electrolytic copper, the Nikolajev works produce

copper directly from matte by the Marchese method, which has, however, been greatly improved. The average grade of the copper matte treated at these works is 26.6 per cent, copper, 46.2 per cent. iron and 13 per cent. sulphur. Antimony is recovered from old antimony alloys and nickel from nickel-iron, the pure nickel produced from the latter assaying 99.8 per cent. The production of white lead is carried on by a secret process, which is probably not very different from those of Tibbits, Thénard and Swinburn.

Cement copper is also produced in a department of the Syrjanov works at Smjeinogorovsk. Electrolytic parting of gold and silver has been carried on for a considerable time at the Imperial Mint at St. Petersburg.

ELECTRIC LIGHTING

A COMPACT ELECTRIC ISOLATED PLANT.

BY WARREN B. LEWIS AND GEORGE E. CHAFLIN.

ISOLATED electric lighting plants are so generally becoming a part of the equipment of new buildings that it seems but a repetition of words to write about a new one. But circumstances alter cases and it sometimes becomes more or less instructive to learn of new conditions and the apparatus which is made to meet them.

The writers have recently had charge of the installation of a small plant in the basement of a newly built and equipped drug store, the conditions governing the installation being somewhat severe. The building is but 20 feet in width inside, 100 feet in length and is seven stories in height. The writers were directed to design an installation comprising boilers, engine, dynamo, pumps, coal storage space, and the usual accessories, and were given a room 35 feet long by 12 feet wide and 8 feet high in which to carry out the design. The boilers were to supply steam for a steam pump operating two hydraulic plunger elevators, an engine to furnish 25 kilowatts in lighting capacity, heat the building and heat water for ten faucets, including three at the soda water fountain. The accompanying sketch of floor plan shows how it was done.

In order to secure as much floor space as possible, the chimney was supported from heavy steel beams on the first floor. The boilers chosen were two Almy water tube boilers, each having 238 square feet of heating surface and 8.2 square feet of grate surface. These boilers are built up of sections of pipes in the form of a box, enclosed by a sheet steel casing, lined with asbestos. These two boilers are rated as 32½ h. p. each, and are 4 feet square on the floor and 7 feet 6 inches high. They were tested at 500 pounds hydraulic pressure at the shops and are operated at 100 pounds. Being so small and steaming at a remarkable rate, it being possible to get up seventy pounds of steam from cold water in less than ten minutes, it might naturally be thought that the steam would hold much moisture, but, on the contrary, it is very dry, so much so that a separator was found to be a superfluity where space was precious.

There is an automatic damper regulator which has to work pretty lively, as the steam pressure may change while the back is turned, although it can be kept comparatively steady after getting used to the steaming qualities of the boilers.

Close to the boilers, on the left, is a return tank and pump which returns the condensation from the heating system to the boilers through a feed water heater, a thermometer in the feed pipe showing 211 degs. F. There is a spare feed pump which is only used in case of emergency.

The blow-off tank is of boiler iron, well riveted together, and rests on a brick foundation in the coal bin.

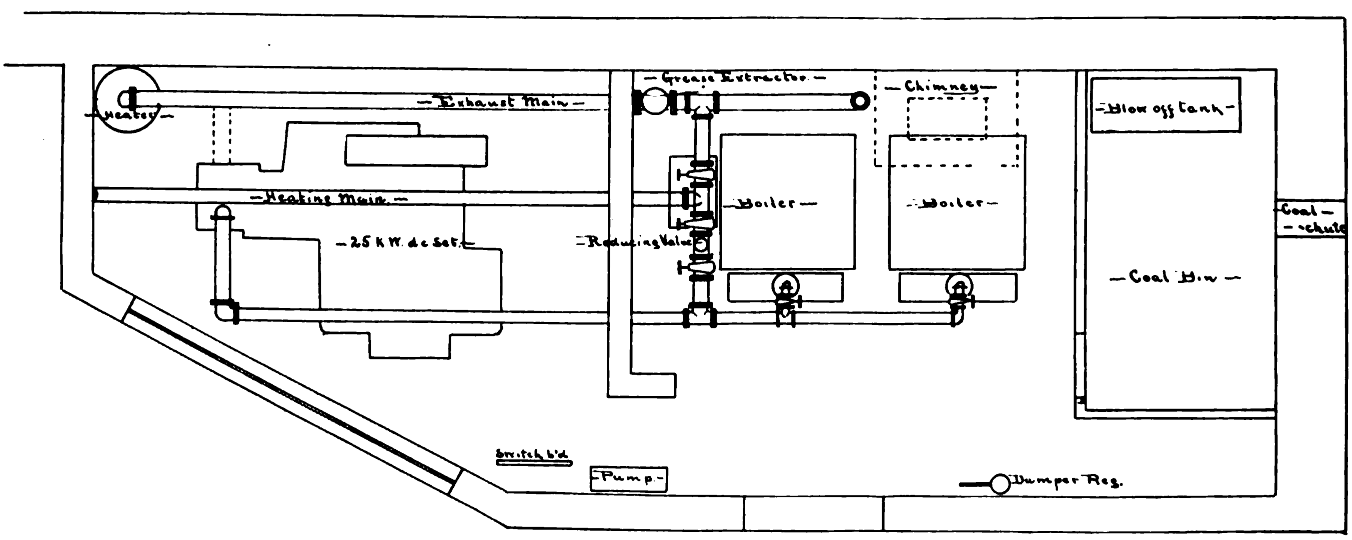
The "generating set" consists of a 9½x10 self-oiling engine, with the Rites governor, built by Armington & Sims Engine Co., and a 25 k. w. G. E. dynamo direct connected. The full load capacity is 225 amperes, although it has carried, without showing any ill effects, 260 amperes. The engine governor is very sensitive, and will check the engine instantly if a fuse blows. The "set" was tested with a tachometer on the shaft and by loading until a fuse blew.

Owing to the fact that the floor was a waterproof one, it was not allowed to build a foundation, and the engine and dynamo rest simply upon two courses of brick laid on the cement floor, with bolts through the brick. There is no perceptible vibration.

The steam piping is extra heavy, with extra heavy gate valves, and has at times carried 150 pounds of steam without showing the least leak. The piping around the boilers and all the feed water pipe is extra heavy brass. All piping, heaters, valves and fittings are covered with asbestos covering.

The illumination of the first floor is accomplished with incandescent lamps set in the ceiling, with a stucco rosette concealing the receptacle, there being one 16 c. p. lamp for each twelve square feet of ceiling. The effect at night is very beautiful. The second floor is illuminated with enclosed arcs, one for each 200 square feet of ceiling. The lamps are hung high and the floor is as light as by daylight.

For a store of these dimensions there is a variety of service, which would be hard to duplicate. The plant runs 18 hours a day and carries a maximum load for seven to eight hours. There is the steam and electric plant, the elevator plant, a pneumatic cash system, the blower for which is run by an electric motor, a carbonator for making soda water as fast as it is drawn from the fountain, and there is to be added a motor for other purposes.



A Compact Electric Isolated Plant.

THE CITY OF HANNIBAL, Mo., has ordered from the Murray Iron Works Co., of Burlington, Ia., a Sioux Corliss engine of 450 h. p. This is to be installed alongside an engine of similar pattern that has been in continuous operation for some years, the intention being to sell more power.

ELKIN, N. C.—Private parties are putting in an electric plant to light the town, and the contract has been awarded to the Electrical Engineering & Supply Co., of Charlotte, N. C., whose secretary, Mr. S. J. Smith, informs us that Crocker-Wheeler apparatus will be used.

THE NEW SALZENBERG ILLUMINANT.

A consular report by Consul P. O. Deuster, of Crefeld, Germany, contains the following description of a new illuminant:

Mr. Ernest Salzenberg, director of the gas works of the city of Crefeld, has invented an improvement in incandescent gas burners, which relates to the production of incandescent gaslight, based upon the discovery that, when the pressure of the gas is considerably increased upon the incandescence body, the said body emits a golden-yellow light, very agreeable to the eye, displaying objects in their natural colors.

The gas is supplied to the burner at a pressure of about 3½ atmospheres, the burner, to withstand this high pressure, being of special construction. A single incandescent jet of the ordinary size can emit a light of much more than 1,000 c. p. The light is of such intensity that a person is enabled to read the finest print at a distance of 100 to 150 feet.

The inventor claims that the cost of his incandescent light of 1,500 c. p. is only 4½ cents per hour, while that of the ordinary electric light of 400 c. p. is (in Germany) 14 cents per hour. In the apparatus constructed by Salzenberg, a hydraulic pressure of 3.5 atmospheres, and even more, may be forced through the improved Auer Welsbach burner. The invention is, however, only applicable where waterworks exist. Mr. Salzenberg has already applied for letters patent in the United States.

ELECTRICAL EELS IN NEW YORK CITY.

The Elm and Duane street station of the New York Edison Company receives its croton water supply from two large service mains at each end of the building. It was noticed on November 11 that the supply from one of these services was cut off. On investigation by the engineer of the watch it was found that they had trapped five eels and one small fish in the eel trap installed alongside the meter. The eels were very large, one of them weighing 2¼ pounds, its length being 29 inches and its circumference 6 inches. As the day was Friday, when the company's staff council has its regular meeting, and when an electrically cooked lunch is served, the eels were at once added to the stock of the commissary department. They proved quite palatable.

LETTERS TO THE EDITOR

THE GEARLESS MOTORS FOR THE CENTRAL LONDON UNDERGROUND.

In your issue of November 11, 1897, there appears an unsigned article entitled "Short Gearless Motors for the Central London Underground," which, without some explanation, is likely to convey a false impression.

The motors which will be used in the Central London Railway are being manufactured for the British Thomson-Houston Company, Limited, by the General Electric Company, at its Schenectady Works, and were designed by the engineers of that company to comply with specifications of the Central London Railway Company.

Some years ago the Thomson-Houston Company acquired the patents growing out of Prof. Short's work, with the Short Electric Railway Company, upon the gearless locomotive, but Prof. Short has had no connection with the work subsequently performed by the General Electric Company in designing and constructing the Baltimore & Ohio locomotives or those now under construction for the Central London Railway. Hence, in so far as the article may convey the impression to the reading public that the locomotives in question have been constructed by, or under the supervision of, Prof. Short, instead of by the General Electric Company, or that Prof. Short has been in any way associated with the work of the General Electric Company in these installations, this impression is entirely erroneous.

This statement is not made with any intention of depriving Prof. Short of any of the credit to which he is justly entitled for highly intelligent and valuable work in the electric railway field, but to remove any possible misapprehension concerning the enterprises in question.

E. W. RICE, JR.,
Third Vice-President, General Electric Co.

Schenectady, N. Y.

PLAIN IRON PIPE FOR CONDUITS.

I HAVE read with interest the articles in your valuable paper, under the above caption, and have waited patiently before addressing you, hoping that someone with a more facile pen would take up the subject and suggest to these Quixotic writers, yclept "Jim Crow," "Doe Bird," etc., that they are tilting at a veritable windmill in the fact that no one in authority, in any city or Board of Underwriters, has even suggested the use of "plain iron pipe" for conduit purposes, much less sanctioned such use. Rule 41 J, of the National Board of Fire Underwriters distinctly says that "pipe must be galvanized, or the interior surfaces coated or enameled to prevent oxidization, etc.," and the rules of the New York Fire Department say practically the same. Then why this waste of space to demonstrate the feasibility of a practice that has never been proposed, and in all probability never will be.

I do not think it any more necessary to discuss the use of plain merchantable pipe for conduit purposes than to waste time in discussing the availability of snow for fuel. Certainly no reputable electrical engineer, with any knowledge of the gas or water pipe business, and the impossibility of getting such pipe smooth inside, without regular machine shop practice, would specify its use. Then, too, once the pipe is clean, the absolute certainty of rust in the tubes and consequent rotting of the rubber and fibre insulation on the wire, would certainly make engineers call for a pipe that was treated in some way to prevent such action. From intimate personal acquaintance with contractors all over the United States, I find that they are becoming more and more inclined to use the best materials and do the best class of work—not because they are forced into it by any existing rules (though they have been a potent influence), but because they intend to stay in the business, and recognize, like any other mechanic, that only good work will bring them assured custom.

So now let Doe Bird and Jim Crow and the others cease to flap their wings and ruffle their feathers, until there is some real question to discuss, like the life of fuses, or the bettering of the insulation on wires, and let me sign myself, as it seems distinctly the fashion,

"HUMMING BIRD."

LITERATURE

CALCIUM CARBID UND ACETYLEN IN VERGANGENHEIT, GEGENWART UND ZUKUNFT. (Calcium Carbide and Acetylene in the Past, Present and Future.) By Dr. Jovan Panaotovic. Leipsic, 1897. J. A. Barth. 124 pp., 5½x8½ inches; illustrated. Paper. Price, $1.50.

Calcium carbide and acetylene literature is increasing rapidly, the electric furnace evidently having given work to the writers as well as to the gas producers.

In the present work the author, after reviewing the history of calcium carbide and acetylene, devotes a number of chapters to the different purposes in industry and the arts, for which acetylene gas may advantageously be employed.

Thus we note that the Pintsch Company, in Berlin, has succeeded in using acetylene in cars, 30 per cent. of acetylene being mixed with 70 per cent. of other gas. In Hungary and Italy several railroad stations are lighted with it, and the railway station at Gerbstedt, in Prussia, has used it since July, 1896. The first-class cars of the night train from Paris to Lagny have acetylene illumination and some tramways in Paris use it successfully. The "Actiengesellschaft fuer Chemische Industrie," in Mannheim, sells liquid acetylene in any desired quantity in bottles containing 5 and 3 kgs. Pictet liquefies large quantities of acetylene in Paris.

The author's statements about the production and sale of carbide abroad are interesting. The works in Neuhausen, Bitterfelde, Luterbach (1,000 h. p.), of the Allgemeine Electricitäts Gesellschaft, have sold their whole production in advance for months.

The author gives in conclusion a list of the carbide and acetylene patents in the principal countries, besides some chapters devoted to the noxious properties of the gas, the hygienic relations, the explosions and to the synthesis of acetylene, so that the book presents a very good, brief résumé of the present state of this industry.

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OUR CHICAGO OFFICE.

THE many friends and patrons of The Electrical Engineer in the West will, we are sure, be glad to learn that its Western office at Chicago has been placed in charge of Mr. W. J. McConnell, who has established headquarters at 1404 Fisher Building, where he will be glad to receive callers or to be advised of any matters of news or business. Mr. McConnell has for some time past represented The Engineer in the Cleveland district and will now have the larger territory to operate in. Kindnesses and favors extended to him will be highly appreciated, The Engineer being desirous to maintain and strengthen the position which it has so long enjoyed in the West, where electrical interests have had so striking a development of late years.

DO ALL INSULATED WIRES INSULATE?

THE progress, indeed the very life, of electrical distribution depends so much on insulation that anything which can aid the engineer in the selection of his working insulations is of value. The insulating power of commercial so-called rubber-covered wires has always been an uncertain quantity, but the margin of safety has in the past been so great and the accidents or fires due to defective rubber-covered wires have been so few, that they have made regular testing by engineers and contractors the exception rather than the rule—the designation of a given standard brand of wire "or one equally as good," being considered a sufficient safeguard. In the light of this practice, the recent tests of Messrs. Stone and Webster, which we publish on another page, are highly interesting. There is nothing like a time test for electrical apparatus of every description and particularly for insulation, and how well, or rather how badly, the majority of the brands of wire tested have stood it, is only too apparent. Of course we do not lose sight of the fact that the conditions under which the test was carried out are not those generally met with in practice, and this is the reason, without doubt, why the inferior brands of wire are still able to serve their intended purpose in the majority of cases with a fair degree of success. Such are the facts. As to the cause of the low average of goodness in some rubber-covered wires now on the market, no one who has followed the course of the wire business for the last few years will be in doubt. A constant lowering of prices due to ruthless competition has unquestionably forced wire manufacturers to cut their cloth to meet the prevailing prices. As the only way to save the situation, the quantity of good rubber in the covering has been reduced, with the results shown. This is a deplorable state of affairs, which in the long run, if continued, will bring with it a reaction disagreeable to all manufacturers of insulated wire, good and bad. One remedy is simple enough, and its application is based on the elementary law of trade that a good article cannot be bought for a cheap price. If the rubber-covered wire "trust" now said to be forming will enable the quality of the insulation to be bettered it will at least have a highly tangible reason for existence.

THE NEW HOME OF THE CIVIL ENGINEERS.

IT is with no small pleasure that electrical engineers will congratulate their brethren in the civil engineering field on the new home which the American Society of Civil Engineers enters this week. Some day, perhaps, they will have a place of their own like it. Such has been their not unworthy ambition for several years past, and the growth and membership steadily brings nearer the time when the hope will be realized. Meanwhile, the civil engineers have secured in this city a house which is in every way in keeping with the dignity and importance of that national body, and with these enlarged facilities they will be better able than ever to do the work for the profession that is always needed. The old house in East Twenty-third street was long since outgrown, but there the society saw many years of usefulness. It was there that generous hospitality was extended to the American Institute of Electrical Engineers in the early days of its struggle, and it might be said with much truth that such help did a great deal to put the Institute on its feet and keep it alive. At one time, it will be remembered, there was a movement for bringing all the engineering societies together under one roof, with a common library of technical literature, museum, halls, etc. In the future that plan may still be carried out, but for the present the prosperous Engineers' Club on Fifth avenue seems to answer admirably the purpose of furnishing a central place for social intercourse between members of the different branches of the engineering art.

RIGHT OF ONE ROAD TO USE ANOTHER'S TRACKS.

A DECISION last month in the New York State Court of Appeals in the case of the Kingston City Railroad Company appears to be giving street railway managers some concern, although many of them do not regard it as a bar to their operations. This decision holds that the operating company must not use the tracks of other roads. It must, to put it briefly, hold a franchise for all portions of the route used; and these cannot be obtained either by lease or by the consent of the company which held the franchise originally, unless given before the new State constitution went into effect, the prohibitive section No. 18 in that document being as follows: "But no law shall authorize the construction or operation of a street railroad except upon the condition that the consent of the owners of one-half in value of the property bounded on, and

the consent also of the local authorities having the control of that portion of a street or highway upon which it is proposed to construct or operate such railroad, be first obtained."

The court says: "We think that when consent is given either in behalf of the public or the abutting owners, to one company, it is for its own use and not for the use of an indefinite number of other companies, regardless of the interests of the city or of the owners of the property on the street." Over in Brooklyn this ruling is being used to stop the operation of the trolley cars of the Brooklyn Heights Co. on the bridge, but President Rossiter, of that company, contends very confidently for the ineffectiveness of the Kingston decision so far as the local roads are concerned. It is a common thing, we imagine, for roads to use tracks in common, for public convenience rather than their own; and when double tracks are proposed for a street the public rises in its indignation. It will certainly be interesting to see how far such a ruling under section 18 will be carried, in its actual effect. It might be made to inflict endless annoyance on railroads and their patrons; but Prof. Collin, a well known State legal expert, holds that there has been a misinterpretation.

"LEAKS" IN THE U. S. SUPREME COURT.

ONE of the most disagreeable stories that have found their way into print lately is that which appears in our Legal Notes, as to a "leak" in the United States Supreme Court, by means of which important decisions have become known in speculative quarters prior to their issuance at the Monday sittings of the court. In this case, as alleged in the lawsuit based on the dispute over the value of the "tip," it is the recent Bell Telephone decision that was given out by a bribed clerk, and a claim for $30,000 as share of the plunder is being made. Mr. J. R. Keene, the well known broker, has issued a letter denying any connection with the incident, and we must now wait for the trial of the case to see how much truth there is in the rest of the startling story. Vague rumors have hitherto been prevalent as to the existence of such leaks as this, but we do not think the United States Supreme Court will allow the matter to go by without sifting it to the bottom, and securing the severe punishment of the offenders, if there be any.

COST OF POWER.

THOUGH power is the very mainspring of modern industry, it is a patent fact that the cost of obtaining it is quite unknown to a large majority of manufacturers. Many of the latter, especially those engaged in small manufactures, are able to and do figure quite closely on the cost of the material entering into their manufactured products; but when it comes to telling what their power costs them they are completely at sea. The cost of power in large quantities has been ably treated of by several engineers, among them Dr. C. E. Emery and Mr. H. A. Foster, but the smaller units have received little or no attention. It is, however, these small units that are the most profitable to the central station. Such installations seldom necessitate the laying down of larger mains, or additional machinery at the central station, and, being scattered on the lines in large numbers, large fluctuations in the power used by any single plant do not affect the lighting system disastrously, as would be the case if the units were larger. It is just in regard to these small plants that the haziest notions as to cost exist, and central station men pushing for such business are not, as a rule, in possession of arguments or figures to convince the power user of the advantages to be gained by using electric power. For such, the series of articles begun in this issue by Mr. Irving A. Taylor will prove of the greatest value. The author has devoted a number of years to the investigation of the comparative cost of steam and electric power, and being, in addition, practically engaged in the work, is eminently competent to shed the full light of experience on this important subject. We know of no topic of greater immediate import to central station managers than this, and feel certain that the figures given by Mr. Taylor will be found reliable.

THE NEW YORK ELECTRICAL SOCIETY—LECTURE BY PREST. PUPIN AT THE NEW COLUMBIA.

A very interesting meeting of the New York Electrical Society was held at the new Columbia University buildings on Morningside Heights, on November 22, when Dr. Pupin, its president, delivered a lecture on "The Physics of the Ether." The meeting was held in one of the rooms of the Engineering Building, and was well attended, despite the threatening weather and the distance that many had to travel. Before the lecture Secretary Guy announced six new members, who were duly elected, and the president gave the details of an excellent programme laid out for the winter's work, providing for several months.

Dr. Pupin then, in an admirable manner, reviewed the history of modern physical theories and discoveries in regard to the ether. He traced the development of the conceptions which connect the ether with the delivery of the energy of the sun to the earth and its functions in the manifestations of light, electricity and magnetism. The work of such men as Newton, Dalton, Faraday, Helmholtz, Maxwell and Hertz was passed in review and brought out in its different phases, and the audience were put in possession of what may be called the latest philosophical opinions or attitudes of mind in regard to what the ether is and what it can do. Dr. Pupin, in tracing his happy analogies, made frequent use of the blackboard, and for more than an hour held his auditors in rapt attention.

After the lecture, Prof. Crocker escorted a large number of the visitors to the power plant, part of which is in operation to furnish light, steam heat, etc., to the University, and the whole of which, when in full running order, will be one of the finest sights in the splendid home of the new Columbia. There are many details of interest connected with the plant, and to some of these attention was called. It was not until after 11 p. m. that the meeting dispersed.

EXECUTIVE COMMITTEE MEETING, NATIONAL ELECTRIC LIGHT ASSOCIATION.

A very busy and successful meeting of the National Electric Light Association's executive committee was held at the Holland House, in this city, on November 22, when there were present President Samuel Insull, Vice-President G. R. Stetson, and Executive Committeemen Messrs. F. Gilbert, J. A. Seely, W. McL. Walbank, G. R. Redman, A. J. De Camp, E. H. Stevens, W. W. Bean; also G. R. Urban, Jr., and ex-Presidents J. I. Ayer and E. A. Armstrong. A great deal of routine business was disposed of and matters of interest to central station managers were discussed. The association was shown by Secretary G. F. Porter to be in excellent shape, and there is every evidence of the continued usefulness and influence of the association in its field of work. It was decided to hold the next meeting of the association in Chicago in 1898, probably in the month of June. The exact date will, however, be fixed later.

PROF. D. E. HUGHES has had the decoration of "Officier de l'ordre Leopold" conferred upon him by King Leopold, of Belgium, in recognition of the great benefits to mankind of his printing telegraph, which is in extensive use in Belgium.

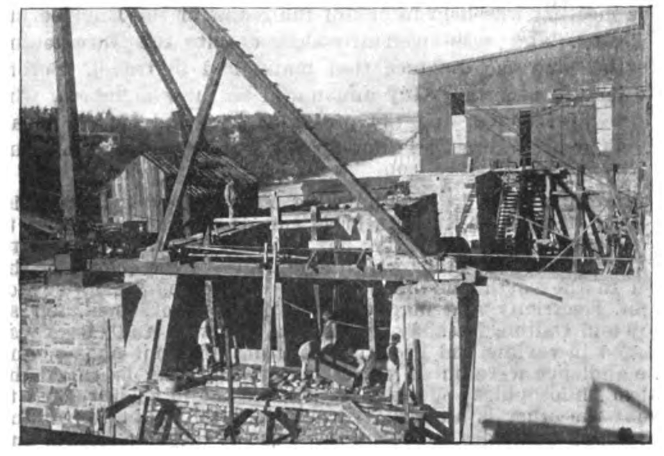
POWER TRANSMISSION

EXTENSION OF THE NIAGARA FALLS HYDRAULIC POWER AND MFG. CO.'S PLANT.

BY ORRIN E. DUNLAP.

THE Niagara Falls Hydraulic Power and Manufacturing Company had hardly completed the first section of their power house at the water's edge in the Gorge before they commenced building an addition to it. It was very early seen that the method of development was a great success, and other demands for electric power forced the company to prepare to serve those who desired to become their customers. The installation in the present section of the power station has been running most successfully, and soon the generators and turbines located there will have companions in the new section.

This new section of the power house is being built on the south side of the original building and of stone quarried on the site. In order to prepare for its erection it was necessary to excavate quite a large amount of stone and debris, but this was rapidly accomplished. The extension necessitated the



EXCAVATING FOREBAY OF NIAGARA FALLS HYDRAULIC POWER MANUFACTURING CO.'S POWER HOUSE.

erection of side walls and the placing of the roof only, as the south wall of the original section of the building was but a temporary structure, which will be removed, and the two sections thrown into one.

The new section of the building is 60 feet long by 100 feet wide, making the total length of the power house as it now stands 120 by 100 feet. The two masonry walls are of the most substantial construction, having very wide foundations and tapering at the top. The tail race beneath the power house floor is 22 feet wide and 30 feet deep. A portion of the tail race is channeled out of the solid rock, while the remainder is built of stone of the same quality as that quarried on the site. All the masonry beneath the floor is most substantial and well calculated to give firmness to the installation.

In the old section of the power house there are eight generators operated by four wheels made by James Leffel & Co., of Springfield, O., and in the new section the present plan is to install five wheels of 2,500 h. p. each. So far, the contract for but one of these wheels has been let, and this to R. D. Wood & Co., of Philadelphia. In addition to these wheels there will be two small wheels to operate two exciters, thus affording them an independent supply of power. The wheel ordered from R. D. Wood & Co. will be used to operate a generator that will supply power to the National Electrolytic Company, who will make chlorate of potash, their factory to be situated on the high bank above, work on its construction being now in progress. This generator will be made by the General Electric Company. It will have 14 poles and will make 257 revolutions per minute, giving an output of 5,000 amperes at 175 volts, or a capacity of nearly 1,200 h. p.

The lands of the Niagara Falls Hydraulic Power and Manufacturing Company, both above and below the bank, present a scene of great constructive activity. Many men are at work developing the resources of the company's possessions in every possible way, well attesting the new life given to the Niagara locality since men turned their earnest attention to the development of its power. Right at the edge of the high bank the work on the forebay extension is progressing rapidly. The forebay extends north and south along the edge of the bluff, the extension now being made being about 100 feet long, 30 feet wide and 22 feet deep. It is directly in the rear of the lower works of the Pittsburg Reduction Company. The walls of the extension are being built of concrete, two parts sand, one of cement and four of stone. Concrete is being used owing to the fact that the company find it cheaper than stone, but some of the walls are faced with stone.

A new canal, 22 feet wide by 20 feet deep, will be built to connect this section of the forebay with the basin of the canal. This canal will be about 300 feet long and run just south of the aluminum plant above referred to. The demands of the installation now being put in will not necessitate the immediate construction of this new canal, as the present canal feeder of the forebay will supply ample water to run the new turbines, but later on, when more wheels are placed in operation, an additional water supply will be necessary, and this is now being provided for with the good judgment that distinguishes the management of the company's business by Arthur Schoellkopf.

The openings into the forebay will be protected by iron gates, which will be operated by hydraulic lifts, as in the original installation. The Buffalo Bridge and Iron Works will make the gates, racks and floor to cover the forebay extension. Improvements will be made in the waste gates so as to avoid all interference from slush ice. The racks at the back of the gates will be 36 feet long by 22 feet high.

The penstock of the first section of the power house hugs the cliff in its descent, but the new penstock will stand out from the bluff in the form of a column, and be of quite an imposing nature. It will be made by Struthers, Wells & Co., of Warren, Pa. Leaving the forebay, it will run out horizontally for about 60 feet, then vertically about 200 feet. It will be 11 feet in diameter until it disappears beneath the power house floor, and then for a distance of about 50 feet it will be 13 feet in diameter. After passing one or two wheels it will taper off in a cone about 18 inches in diameter to form a head, and end in an air chamber 15 feet high by 4 feet in diameter. The thickness of the steel in the penstock will vary from 5/8 to 1 1/8 inches in thickness. The penstock and wheels will be supported in the new section by heavy posts and beams, all parts of which will be made adjustable. This portion of the installation will be made by the Variety Iron Works, of Cleveland, O. Wallace C. Johnson, M. Am. Soc. C. E., is chief engineer of the Niagara Falls Hydraulic Power and Manufacturing Company, and has full charge of the work, which is being done in accordance with plans made by him. Frank G. Lott is the electrician of the company, and has charge of the electrical department.

The canal of the Niagara Falls Hydraulic Power and Manufacturing Company was one of the earliest conceptions for the development of the power of the Niagara region. Its right to take water from the upper Niagara river for power purposes has been recognized in full by the State of New York, and for five years the work of developing the canal has been in progress. The inlet of the canal is at Port Day, where it is 250 feet wide, tapering to a width of 100 feet in a length of 400 feet. The width decreases further down its length, but the company own the land to increase it to 100 feet wide for its entire length whenever they deem it wise. Last summer the average depth of the canal for a width of 40 feet was made 14 feet, in addition to the old channel 30 feet wide and 8 feet deep. In other words, the canal for the main part of its course has a width of 70 feet, 40 feet of which is 14 feet deep and 30 feet 8 feet deep. This channel of 14 feet is on the north side of the waterway down to Third street, in the city of Niagara Falls, when it crosses over to the south side, along which it runs down to the basin in the milling district. It is on this lower section that the drill boats and dredges are now at work.

One notable feature of the development of the Niagara Falls Hydraulic Power and Manufacturing Company is that the work on its power house extension, forebay, canal, etc., is all done by men employed by the day instead of by contract, which in the majority of cases is the practice. However, the power company are well satisfied with the results of their method, and speak in praise of it. The expenditure on the part of the company during recent years has been an important factor to the general business of Niagara Falls.

CANADIAN NIAGARA POWER.

The Canadian Niagara Power League has been formed in Niagara Falls, Ont., the object of the organization being to exert all possible efforts to further the development of power on the Canadian side at Niagara. For some little time the plan of the organization has been discussed, and on November 9 the formal organization was perfected by the election of John F. Macklem, of Chippewa, as president; F. J. Hill, of Niagara Falls, Ont., as secretary-treasurer, and the following vice-presidents: R. P. Slater and C. G. Cole, of Niagara Falls, Ont.; Reeve Cook and E. P. Dalton, of Niagara Falls South, Ont.; Messrs. Hazlett and Herbold, of Chippewa; Mayor Griffith and S. J. Sidey, of Welland.

The meeting referred to was a most enthusiastic one, and speeches filled with enthusiasm were made, it being the expressed belief of all that the interests of the Canadian side would be materially advanced by the development of the available power of the locality.

ELECTRIC TRANSPORTATION

THE KOPPEL PORTABLE ELECTRIC RAILWAY SYSTEM.

THE question of the design of small locomotives for use on pioneer lines has been always a difficult matter.

The needs of the railway contractor have called for such locomotives, for which several systems of power have been tried. In many ways the electric locomotive has distinct advantages over its rivals, steam and compressed air, for these narrow-gauge lines. Reviewing these advantages briefly, we see that the electrical equipment is more economical to work, as one good stationary engine develops power much more cheaply than several small locomotives. Again, the electric locomotive can be more readily designed for narrow-gauges than steam or compressed air locomotives.

A new system of equipment of such lines, says the London "Electrical Engineer," is now being introduced by Mr. Arthur Koppel, of London. The keynote of this system is flexibility,

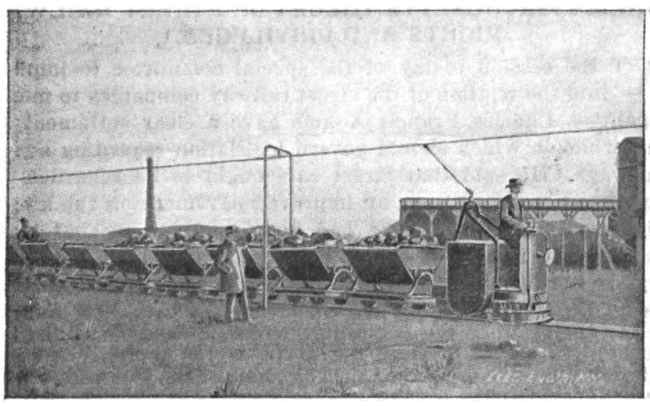
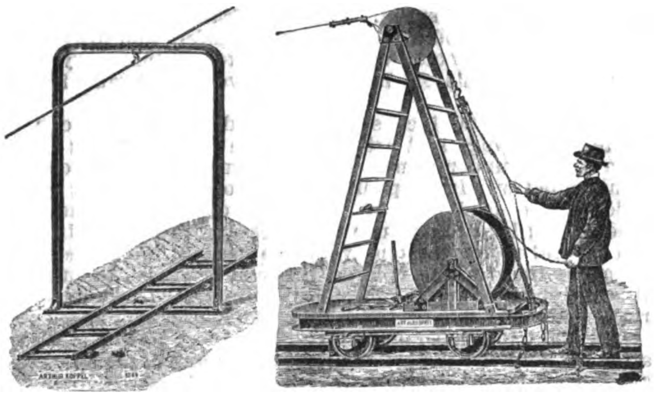


FIG. 1.—ELECTRIC LOCOMOTIVE AND SKIPS, KOPPEL SYSTEM.

the arrangements being such that extensions or alterations can be readily effected. In fact, the line is portable, and is claimed also to be cheaper than the ordinary construction. The overhead conductor is employed, as can be seen from Fig. 1, which gives a general view of a locomotive and train of skips on a line actually at work. The supports for the wire are not provided by separate posts and brackets in the usual way, but by arched carriers attached to the section of the railway line, thereby forming a portable section of the electric railway, as illustrated by Fig. 2. The steel carrier, or "arch," is fixed to one of the sleepers, which is made of sufficient length for that purpose. On the straight line these line supports are placed about 25 yards apart. In curves of a small radius each section of tramway is provided with an arch, to keep the line of the wire as nearly as possible parallel to the curve of the line. Apart from these special extended sleepers with wire carriers attached, the line is constructed in the ordinary manner with rails 14 pounds per yard and upward. As the electric locomotives are lighter than steam locomotives, the weight of the rail required is somewhat less.

The special trolley for erecting the wires along the railway line is shown in Fig. 3. This consists of an ordinary four-wheeled platform wagon with ladder, and wire drum with tightening gear and clamps or grips for anchoring the trolley to the line. The wire is led over a sheave on top of the ladder



FIGS. 2 AND 3.—TROLLEY ARCH AND METHOD OF STRINGING WIRE.

and fixed to the picket post at the beginning of the line. When erecting the wire the trolley is pushed beyond the first carrier arch, clamped on to the rails, and the wire is then tightened by means of the tightening gear. It is then firmly fixed to the insulator on the carrier arch. The tension in the copper wire is taken up by a second portable ladder, which is also provided with a tightening gear and can be clamped to the rails in the same manner as the trolley, so that the trolley can then be pushed behind the second carrier arch and the process previously described repeated. By the tension in the wire the carrier arches acquire the necessary stability, while without the procedure previously described it would be impossible to use such light arches attached to the sleepers. On permanent lines, the extreme ends of the wire are attached to properly anchored picket posts. On portable lines, on the other hand, the trolley with the wire drum is fixed to the rails at the end of the line, as shown in Fig. 3, so as to enable the line to be lengthened or shortened as may be required with ease.

Care is taken in insulating the drum and ladders so as to prevent leakage from this erecting trolley to earth. The feed-

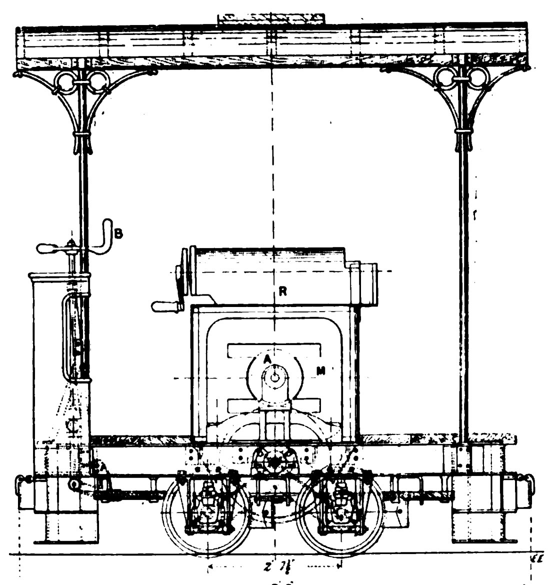


FIG. 4.—ELECTRIC LOCOMOTIVE FOR KOPPEL PORTABLE ELECTRIC RAILWAY SYSTEM.

ers from the power house to the overhead wire and to the rails respectively are erected on light iron posts, which have also been standardized by Mr. Koppel.

The locomotive used is varied in form with the gauge of the line, but we are particularly concerned with those for gauges under 24 inch. Fig. 4 shows the details of the electrical and mechanical parts of this locomotive when fitted with a platform at either end, and with a hood. The motor, M, is of the

internal pole type, and is supported on the underframe of the wagon. A double gear is used. The first is a spur gearing, connecting the motor to a countershaft placed under the motor. This gear reduces the speed of rotation to about 200 revolutions. The countershaft is then connected to the two axles of the trolley by chain gearing. This gives the necessary flexibility between the car body and the wheel required, as the springs give to any inequality of the rails. In this gearing there is no change of speed. The underframe is provided with spring axle boxes, and also with spring buffers and draw-bars. The speed of the motor can be regulated within very wide limits by the regulator, R. An effective hand-brake is also provided.

For gauges of 20 inches and upward the motors can be mounted on springs and attached to the running axles inside of the wagon underframe. This construction is particularly recommended by Mr. Koppel where, in order to mount heavy gradients, the dead load of the motor car must be assisted by the paying load to produce the necessary adhesion. In such cases several motor wagons would be used in the same train. As regards the working voltage, this can be varied to suit special requirements, but the locomotive illustrated was designed for 110 volts. At this pressure its possible working speed was at least eight miles per hour. The supply of power is also a matter not referred to particularly, as in many cases a lighting plant is used by the contractors, which could also be employed to provide the necessary energy for the electric railway.

SOUTH ORANGE & MAPLEWOOD TRACTION CO.

The above company has just put its road into operation. Mr. Frank Brewer, the president, sends us the following details: "We have 5.2 miles of track, built entirely through private property, except for a distance of 440 feet, where we run on South Orange avenue. On this part we use 90-pound girder rail, the rest of the distance a 56-pound T rail on ties two feet apart, center to center, under which we have six inches of cracked stone, which gives us as solid a roadbed as a well ballasted steam road, the street crossings are paved with Ohio vitrified brick laid on concrete, with a 1-inch sand cushion, the spaces between the brick being grouted with cement. There are 4 motor cars, G. E. 800 motors, Brill trucks and cars. We connect at South Orange with the D., L. & W. Ry., the Newark & South Orange Electric Railway, and we give transfers to the Suburban Traction Company at Orange Valley, and at Main street, Orange we connect with the Watchung branch of the Erie Railway and the Consolidated Traction Company."

ELECTRIC ROAD FOR JAMAICA, W. I.

Mr. Wm. McKenzie, Toronto; Mr. W. B. Ross, Q. C., Halifax; Mr. R. C. Brown, Halifax; Mr. B. F. Pearson, Halifax; Mr. R. D. McGibbon, Q. C., Montreal; Mr. Granville C. Cunningham, Mr. W. B. Chapman, Montreal; Mr. H. M. Whitney, Boston, Mass.; Mr. F. S. Pearson, New York, and Mr. James Ross, Montreal, have secured a charter and franchise from the Jamaica government to build electric tramways on the island.

The capital required is over $500,000, and will be furnished by Montreal and Halifax capitalists. Construction will commence at Kingston, where the old tramway system is to be converted into one of the latest improved electric roads. A large power house is to be built near the shore, and an electric lighting plant will also be put in. Mr. F. P. Brothers, superintendent of the construction work of the Montreal Street Railway Co., has left for Jamaica to take full charge of the work of construction.

LONG DISTANCE TROLLEY FOR LONG ISLAND.

The Cross Country Railroad Company, of Long Island, filed its certificate of incorporation last week. It is understood that some of the principal men of the Nassau Electric Railroad Company are interested in it, but that the only direct interest which the Nassau Railroad itself has in the new enterprise is as a possible feeder for its lines.

The route will be largely over private property, which has already been secured. The new line will be fifteen miles long, and will connect the villages of College Point, Whitestone and Flushing with Jamaica and the Twenty-sixth Ward of Brooklyn. By changing cars at the latter point passengers can reach the Brooklyn Bridge by either the Nassau Railroad or the Kings County Elevated Railroad.

The company has a capital stock of $250,000. The directors are Joseph McClean, Andrew A. Halsey, Theodore Bernard, Charles H. Kelby, George Kellar, James Crowley, Francis Bacon, James Erwin and Charles Brandon, of Brooklyn.

THE LEWISBURG, MILTON & WATSONTOWN, PA. ELECTRIC RAILWAY.

Work is now being pushed with great vigor on the construction of the electric railroad beginning at Lewisburg, Union County, and running to Milton and thence to Watsontown, Northumberland County, Pennsylvania. The road, which is being built by Mr. E. A. Tennis, president of the Tennis Construction Co., of Philadelphia, and Mr. J. W. Champ, superintendent and general manager, will be nine miles long. The power house is situated at Milton, and there will be shortly in position one 400 h. p. Corliss engine.

The same company has purchased the electric light plant at Milton and will enlarge the power house in order to make room for the additional equipment necessitated thereby.

A large force of men is at work on the track construction and General Manager Camp is straining every nerve to have cars running by Christmas.

271,560 MILES ON A STREET CAR.

Mike Dooley, a St. Louis car driver, has traveled 271,560 miles in 31 years, all on one street. Practically his entire working life has been passed in this way. Sixty days' absence because of sickness constitute the only interim in a long, monotonous career on the front platform. For one other day he was laid off because he was caught smoking a cigar while on duty. He holds the record among the street car drivers of the country for the longest unbroken service. He has worked 365 days in a year, and has averaged 24 miles a day, or 8,670 miles a year. His hours have been sometimes all day and sometimes all night. Just now he is driving an "owl" car, going on duty at midnight. He likes this work, and wouldn't exchange it for that of any street car man in St. Louis. He has never received but one price for his labor—$2 a day. He has therefore received from the Missouri Railroad Company during 31 years the sum of $22,650. He has traveled far enough to have completed the circuit of the earth eleven times and a half.—St. Louis Republic.

THE MASSACHUSETTS THEORY OF STREET RAILWAY RIGHTS AND PRIVILEGES.[1]

At the session to-day of the special committee to inquire into the relation of the street railway companies to municipalities, Charles Francis Adams gave a clear statement of the principle which should govern legislation regarding street railways. He said that street cars ought to be regarded as omnibuses, running upon an improved pavement on the king's highway, and that if they had been regarded in that light there would not have been the present confusion in considering street railway corporations in their relation to the municipality through whose streets their cars are run. Mr. Adams is the chairman of the committee which is conducting the investigation on the part of the State, which is really a commission, just like any other special commission, but which was called a committee because there is such a prejudice against the name commission that the resolve might not have got through the Legislature if the inquirers had been labeled by their true name. The other members are William W. Crapo, of New Bedford, and ex-Mayor Elihu B. Hayes, of Lynn. The committee were appointed by Governor Wolcott under an act of the last Legislature "to investigate the subject of the relations between cities and towns and street railway corporations, the taxation of street railways and their franchises in this commonwealth and in other States and countries, and the need, if any, of legislation in this commonwealth to establish a more fixed tenure of franchises of street railways, and an equitable method of taxing the same."

The hearings which are going on this week are a part of the general investigation which is being made. During the summer Mr. Adams was in Europe in the service of the committee, under that clause of the act which covers "other States and countries," learning the systems of tenure and taxation which prevail there. The other members of the committee have been busy on this side of the water, holding meetings and making investigations in cities where something new was

[1]New York Evening Post, Nov. 16.

to be learned, especially in Detroit, Chicago and Toronto. Inquiry out of the State having been ended, they have heard already the mayors and the selectmen in every city and town in the State which has street railways, as far as they cared to be heard. Now they are busy with the side of the corporations, and after the counsel for the various companies have shown to the committee why no further burdens should be put on them, they will open their hearings to the general public. The report of the committee must be made to the Legislature by February 1 next.

This committee was created in consequence of the fact that thus far in Massachusetts, as doubtless in most States of our Union, no charge is made to any street railway corporation for the use of the streets. When these "omnibuses on improved pavements on the king's highway" were first put in operation, the people were only too glad to give them right of way in the streets, letting the corporations take the chance of making whatever profit they could. It is only as the cities have grown and the number of passengers has multiplied faster than the population, and the great value of the franchises has become apparent, that this public demand for payment for the franchise has arisen. Mr. Adams, commenting to-day upon an argument and statement of facts which was presented to the committee by a representative of the country lines of electric cars, said that if the Legislatures had not made the mistake of following the anology of railroads in their treatment of railways (for in Massachusetts, by statute, "railroads' are the steam lines running on their own locations, while "railways" are the street, horse, and electric lines, running upon public locations), it would have been possible to charge licenses for the operation of the street lines, just as lines of omnibuses used to be licensed, and this difficulty about charging for the franchise, or about the methods of taxation, would not have arisen. In order to reach a satisfactory theory for the treatment of railways some way must be found out of the original error of regarding them in the light of railroads.

The representatives of the cities and towns have declared to the committee that they ought to be reimbursed for the burdens which the corporations put upon the taxpayers, and for the valuable rights which are granted. It is a nuisance, it is argued, to have the tracks in the highways, although the corporations must keep the space between the tracks and eighteen inches on each side paved. The profits, they say, which arise from the existence of a large population, and which are not due to the enterprise of the railway corporation, should be given to the people who make them possible, and not be put into the private pockets of corporation stockholders. On the other hand, at the presentation of their side of the case by the corporations to-day, one would think that they were such servants to the public that the people ought to welcome them on present terms. The Massachusetts Street Railway Association, which has been in existence for years, and has been felt repeatedly as a power at the State-house, on account of the combined action of the corporations all over the State, has secured as counsel one of the best lawyers in Boston, and is making as strong a fight as possible for corporation privileges.

Aside from the arguments for the railways, the sketch of revolutionized rural conditions which was drawn was most interesting. It was said that electric lines from outskirts to town centres have made it possible to abolish small schools and to bring all the scholars of a town to one central building, where the employment of better teachers and the use of better methods is practiced. The lonesome farmer is now carried by electrics to the neighboring town or city in the evening, where he enjoys lectures and concerts (the sagacious counsel did not mention "theatres"), and is taken home again with a dispatch never thought of in old times. School children and municipal employés are carried at half fare. Church-goers enjoy the privileges of worship on the Sabbath to a degree never before known. The electric lines strengthen the social tie as was not dreamed of in bygone days, and promote a community of interest and develop a body of public sympathy and opinion, which the rural population of the past has never pictured, even in imagination. On the financial side, the country corporations make the plea that the towns oppress them; that they make them pave their tracks when the rails are so far on one side of the highway as to make pavement ridiculous; that they have to build new bridges in consequence of the disposition of the towns to make corporations bear all that can be thrown upon them; that they have to construct culverts and to put in cattle guards; that they have to regrade roads and build extensions to bridges, to make room for the additional service; in short, that they have all that they can possibly stagger under already, and that they are not at all fit subjects for further taxation.

Whether the committee will discriminate between rural and city railways, of course no one can foretell, but it is evident that there is a strong sentiment in the community for holding the city railways to closer account to the people. During the year ending September 31, 1897, the West End Street Railway carried, by its returns just published, 200,000,000 passengers. The public is firmly convinced that this corporation ought to make some return to the city.

In regard to the clause in the act about "more fixed tenure of franchises," it is to be said that the practice in this State, as doubtless in most others, is that theoretically the tracks may be ordered up at any time at the pleasure of the aldermen, but that practically the tenure of the corporation is secure. At legislative hearings this point has been brought up repeatedly, but the representatives of the corporations have not been able to show that their stocks or bonds sold at less price because of this theoretical exposure to popular wrath or to aldermanic avarice. But the clause was put into the act in order that if additional burdens are recommended for street railways additional security may be given to them in return. Considering the standing of this committee, and especially the railroad experience of Mr. Adams, it is expected that it will throw much light upon this subject of the relations of street railways to municipalities, and the policy to be pursued in licensing and taxing the corporations.

MALICE AT GOSPORT, IND.

A special dispatch from Martinsville, Ind., of November 8 says: Some weeks ago the Town Board of Gosport contracted with the Gosport Electric Company for ten electric lights to be used on the streets of that place. At a special meeting two nights later the Town Board rescinded the contract, but the company went on with the work. The Town Board then sought the protection of the Circuit Court, and attempted to have an injunction issued against the company to restrain it from carrying out the contract, but the court refused to interfere. Last Monday night the company started the lights. On Tuesday some one gained an entrance to the power house and took the oil and packing out of the main shaft bearing and filled it with sand. As a result the bearings were melted out and the machinery had to be shut down for the night. On Wednesday some one soaped the boiler, and it was necessary to clean it out before steam could be raised. Since then a guard has been on duty at the power house, when the plant was not in operation, and now some one has been tampering with the lines. The vandalism seems to be the work of one familiar with machinery, but the electric light people are at a loss as to his identity. The carrying out of the contract has caused considerable feeling, but the citizens are for the most part in favor of the lights.

MECHANICAL

THE FLETCHER WAVE MOTOR.

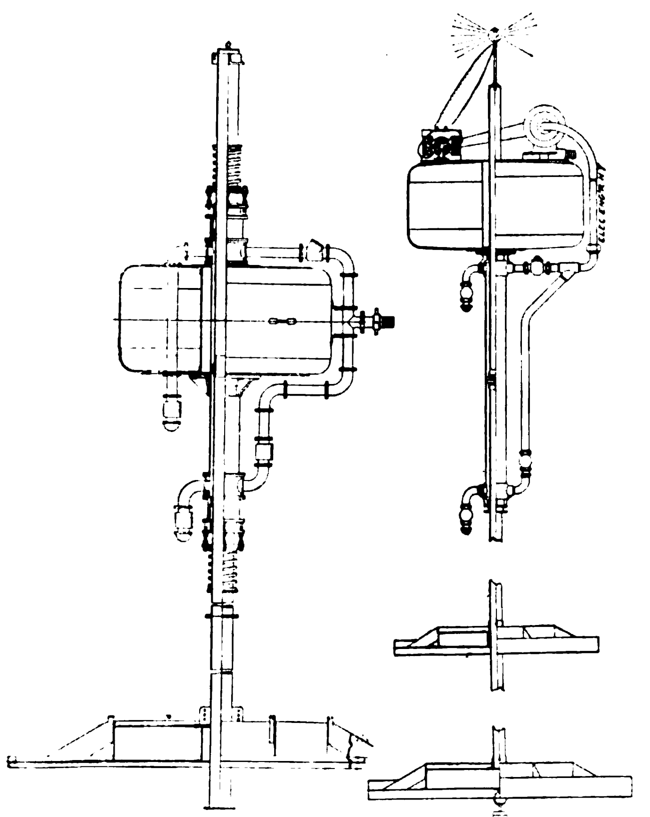
In our issue of April 21 we illustrated and described a highly ingenious and novel form of wave motor designed by Mr. B. Morley Fletcher, of London. This form of motor has recently been put to an experimental test, being moored to the ship "Wendla," anchored a mile outside of the promenade pier at Dover, England. The "Wendla" is intended to form a power station upon which to accumulate and utilize the energy obtained from the waves.

The plant consists, as may be seen in Fig. 1, of two principal parts, viz., a hydrometer tube with submerged table, and an oscillating buoy, with hydraulic pump, gear, etc. The hydrometer tube is composed of welded steel 12 inches in diameter, and is adjusted to float in position with its upper end from 10 feet to 13 feet above the normal water level, while its lower end is secured to the submerged table, the total length of the tube being about 30 feet.

The submerged table is constructed of steel plates, stiffened and strengthened by means of brackets, gusset stays, angle rings, etc., also of steel; the outside diameter being about 20 feet. The table is also provided with suitable fittings for mooring chains. An air chamber is also constructed on its upper surface in order to augment the buoyancy of the whole structure. The lower end of the hydrometer tube is stepped on the submerged table, and is secured thereto by means of a

specially constructed cast-iron bracket. The piston is fitted to the hydrometer tube at a few feet below the water level. It is composed of gun metal and is constructed of an annular form and surrounds the steel tube, which tube acts as a comparatively stationary piston rod, around which the cylinder and oscillating buoy operate.

The oscillating buoy is of cylindrical form, and is composed of thick steel boiler plates riveted together, and is in all respects of boiler construction. The diameter is about 10 feet and depth 5 feet. In the center and throughout its depth a strong steel tube is riveted in place, the top and bottom ends being firmly secured with angle rings. This central tube is of sufficient diameter to admit of the cylinder, together with its stuffing box, protruding for a short distance above the top of the buoy, and of sufficient length to enable the stuffing box to be continued for some distance below the bottom of the buoy. The buoy is provided with suitable manholes, fitted with watertight covers, in order that an inspection of the internal parts may be made when desired; and the whole structure is of such strength and thickness as to withstand the roughest possible usage, the total weight being between 11 and 12 tons. In the event of it being desired to increase the hydraulic pressure, the apparatus is so designed and constructed as to be capable



FIGS. 1 AND 2.—FLETCHER WAVE POWER MOTOR AND LIGHT BUOY

of being loaded by several tons of additional weight, such as pig iron.

The pump cylinder has a maximum stroke equivalent to 10 feet, the internal diameter being 16 inches. Thus the piston area comprises the annular space between the outside of the hydrometer (acting as a piston rod) and the inner walls of the cylinder. The cylinder, like the hydrometer tube, is of welded steel. Substantial cast iron stuffing boxes are fitted at the top and bottom ends, the glands of which, however, are of gun metal. The illustration shows two hydraulic suction and two delivery valves actuated by each rise and fall of the pump cylinder and oscillating buoy. The pressure at which the water is delivered—say, on to the "Wendla"—is equivalent to that of a head or fall of fully 300 feet, observing that this pressure is not dependent on the length or height of the waves, the quantity of water varying alone with an alteration of the length of stroke. With respect to this, and having regard to the experiments already carried out, we understand that the inventor, Mr. Morley Fletcher, has devised a telescopic adjusting arrangement for increasing or diminishing the immersion of the tube, as well as other improvements sufficient al thereto. It is to be noted that the apparatus is provided with efficient spring buffers in order to obviate shocks to the piston at either end of the stroke.

When the apparatus was secured in its working position in the sea at the stern of the "Wendla," and the 6-inch hose led on to that vessel, it immediately commenced to pump a large column of water on the deck, extending for fully one-half its length in a fore and aft direction, but unfortunately sufficient hose was not then available to connect with a large turbine fixed on board.

An apparatus has also been devised by the inventor for—instead of pumping water—so arranging the pump as to compress air into a portion of the buoy divided off to form an air-chamber; by means of mechanism the air was permitted to escape, and being led through the ordinary reeds of a fog-horn, produced notes of varying duration.

In our issue before mentioned we made reference to the application of this invention to electrically lighted buoys to be used as beacons, or for salvage operations, harbor works and the like.

Fig. 2 illustrates one form of such a buoy, which is the smallest actual pumping machine and complete electrical installation designed and constructed by Mr. Morley Fletcher, up to the present, on his wave motor principle. It comprises, as in the larger motors previously described, a double acting pump, the maximum length of stroke being about two feet. It is capable of delivering water at a pressure—notwithstanding the height of the wave—equivalent to a head of water 30 feet to 40 feet, and as in previous apparatus the quantity of water and not its pressure, is controlled by variations in the height of the wave, and consequent shortening or lengthening of the possible stroke of the piston.

The apparatus at work in the sea off Dover, and as shown in Fig. 2, consists of an hydrometer tube about 1½ inches in diameter, and from 11 feet to 12 feet long, with its two submerged table resistances. The tube is of solid drawn brass. The two suction valves (one being vertical, and the other horizontal) are both steam valves, and trap so effectively that the pump, though designed for water, delivers air occasionally most effectually. The buoy, above the pump, is about 18 inches in diameter, by about 8 inches deep, and is constructed of thin galvanized iron. It is, however, sufficient in its lifting force and falling weight in the waves to develop a total pressure on the piston of fully 40 pounds; on the top of the buoy a complete hydraulic-electrical installation is fitted, consisting of a small turbine, dynamo, switch, and electrical lantern, or small festoon of lights as may be desired.

In this apparatus the water, instead of being pumped away from the wave motor on to an attendant vessel or power station, returns upon the turbine fitted and secured upon the buoy itself, as shown. The turbine is by this means revolved at a rapid rate by the stream of water thus delivered upon it, and is connected by suitable gearing—by preference a rod, with spur gearing—to a small dynamo, which is enclosed, together with the driving gear and turbine, in a metallic watertight casing, provided with an efficient stuffing gland for the rod or shaft. Thus we have an extremely small and simple machine, or apparatus, worked and driven wholly by the action of the sea waves upon it, capable of giving a light of far greater brilliancy, with far greater effect and with less trouble than is the case with the large gas buoys which are employed as marine beacons around the English coasts.

It will be readily understood from the illustration and from the foregoing description, that in so small apparatus as this, and having regard to the serious loss due to friction and to other causes, the difficulties to be surmounted in order to achieve a successful result are very much greater than those likely to be met with in the designing of the larger sizes of wave motors before referred to, but, nevertheless, the apparatus at Dover commenced to revolve the turbine the moment it was placed in the sea and became subject to the action of the waves. By way of comparison, a large Trinity buoy of the type so plentifully distributed around the English sea coasts, and weighing nearly eight tons, when constantly rising and falling in the sea waves through a distance or stroke of nearly one foot, at a frequency of say thirty strokes per minute is capable of developing sufficient power—were it utilized and applied to the purpose of a light-buoy or as a beacon—for some 600 incandescent lamps of 8 c. p. each, or of driving machinery to the extent of fully 32 h. p.

The satisfactory results, therefore, that have already been obtained by the various apparatus above referred to, have established the fact that Mr. Morley Fletcher has succeeded in tapping and utilizing that illimitable source of energy developed by the waves of the sea, and at such a reasonable distance from the shore as to use the power so derived either on land or on floating structures, for purposes too numerous to mention.

We are indebted to "Industries and Iron" for the above details and illustrations.

THE COMPARATIVE COST OF STEAM AND ELECTRIC POWER.—I.

BY IRVING A. TAYLOR.

PERHAPS of all problems having a direct bearing on the success of manufacturing enterprises, that of the economical and convenient supply of power to various classes of machinery under varying conditions receives the least attention. And not only does the matter command little thought, but that which it does command is generally erroneous and goes wide of the practical mark at which it should aim. This condition is necessarily existent for two reasons. The one, that the cost of power has generally been felt to be a rather small item in the total cost of manufacture; and the other, perhaps the prime, the fundamental, reason, is that the problem of power distribution is such a complicated one as to require the special knowledge and experience of a trained engineer in order to cope with it. Not that the mere supply and distribution of power is difficult—there is nothing easier—but to do it, when all things are considered, with the highest practical economy and convenience—this is the "asses' bridge" at which the generality of modern managers stick, and resign themselves to the whims of guesswork. And a sorry enough sight this same guesswork generally produces; shops and foundries littered up with a mass of belting and other rude mechanical devices which prevent the use of overhead carrier tracks—those, I had almost said, "magic workers" of the modern factory—hinder the workmen in their movements to such an extent as is only appreciated when they have been relegated to the scray heap, and absorb such a large proportion of the total power produced, as the price of transmission, that, could we once free ourselves entirely from them, we would gaze back in wonder to think that we could ever have worried along under such a mass of cumbrous trappings.

To say that the simple cost of power, even when the cost is rightly counted, is the only factor in the case which is worthy of consideration, leads directly to the position previously mentioned, that the whole matter is one of little moment and carries practically no weight in the ultimate financial, the practical business, result. As one makes a careful examination of the various phases of the question, the fact of a slight variation either way in the already small item of power cost, bears less and less significance, and the factor of convenience—the quality which enables a greater production to be obtained from a given amount of labor and machinery—looms up to its proper dimensions, and finally appears for what it really is—one of the most important questions arising in shop management, the judicious settlement of which is of enormous moment.

The writer is not in favor of doing away in every instance with the old fashioned methods of energy generation and transmission; they have not entirely outlived their usefulness, and the conditions are entirely too varied to lay down any general rule regarding the best system to use in every case; but he feels that this matter of convenience—convenience cannot be talked too strongly.

It is surprising how few manufactories are arranged with any degree of intelligence, even in those where in some respects the most advanced machinery and processes are used, and where a person would naturally expect to find the best engineering skill displayed, there exist horrible examples of antique practices—methods displaying more genius, of the Chinese puzzle pattern, than brains—methods of throwing away power and of misusing what is left of it, which grate harshly on the soul of one who is used to seeing the precious commodity intelligently metered, and, what is more to the point, in some few instances, intelligently used.

The writer recently talked with the manager of a concern which had enlarged and entirely remodeled their shops some few years ago in order to handle an increased business, the idea being that a capacity of four times the original amount would be amply sufficient. The tools used did not differ largely from those used previously, but the simple, practical methods of applying the power to them are beyond criticism. The results have been astonishing. Large orders, dependent somewhat upon rapidity of execution, were received, and being successfully handled, their business soon increased beyond all anticipation until at present nearly seventeen times the original work is being done, with no confusion, no worry, and the limit has not yet been reached. Electricity has been the prime mover, and compressed air, electrically produced, has been a second mover for certain classes of machinery in which it has been impossible to apply electricity directly. The compressed air here is a clear instance of the weight of utility over cost. The air power is essentially a costly power, as the efficiency from electricity to the air motors, the air being used cold, is not over 15 per cent.; but the labor account is so far reduced, and the amount of work obtainable from the machinery so greatly increased, that no reasonable difference in the actual power cost would have any weight whatever. Nor is this an isolated case, though it must be admitted that the same success is not always met, even in electrically driven plants, for the very obvious reason that brain power has been too ardently restrained while they were being designed.

THE BEST WAY TO LAY OUT A POWER PLANT.

The question has often been asked: "What is the best way to lay out a power plant?" and the theoretical answers to it have covered the territory all the way from low cost to high cost, and from low convenience to high convenience. Meanwhile, a practical answer, of a general nature, has been slowly and surely moulded. This answer, broadly speaking, seems to assert that, in all instances where large amounts of machinery are to be operated, certain "power centres" may be found, to which, while power is being used, it may be supplied at a fairly constant rate, i. e., with a high load factor. These power centres may supply a single machine, or a group of machines, or, it may be, a floor, or section of a shop. Mechanical transmitting devices are used, but care is taken that no very large amount of power is transmitted over a long line of shafting or a number of belts. When electric motors are employed to operate these centres, there seems to be no limit either way to the size which may be economically or conveniently used, though there is a tendency toward the use of medium sizes, say, from 3 to 15 horse power, the chief desiderata being that they shall be fairly well loaded, while they are in use, and that high total efficiency and convenience shall not be sacrificed by the use of a complicated belting system.

In almost all cases where the load on a single machine, or on a group of machines, all of which it will be desirable to operate at the same time, is nearly constant, it is found best to connect the group or unit as directly as possible to an individual motor; while those machines which consume a variable, but small, amount of power, should be grouped together in sufficiently large quantities to prevent serious fluctuations in the total demand made at any one motor shaft. Groups of machinery making a variable demand for power should, in general, be operated separately from those demanding a constant amount.

To illustrate, suppose we have a blower or other constant load, which we wish to operate all day at 5 horse power, and one or two machines which will consume from zero to 10 horse power and average about two horse power. The costly part of this load to run will be the blower, and the rest of the machinery will only take a relatively small amount of power any way it is arranged.

If we bank the whole load on a 15 h. p. motor the costly part of it will be making its average run on a half loaded motor, through belts, shafting, etc., and costing probably double as much as it would if direct connected to a 5 h. p. motor shaft. This group should therefore be operated by two or more motors; whereas, the maximum load of 10 h. p. on the extra machinery being the same, if the average demand for power by the extra machinery had been 7 or 8 h. p. it would be more economical to operate the whole group by one motor.

But it makes little or no difference how much care and ingenuity have been expended in supplying the power to the counter-shaft, if the latter is bent or out of line, supported from weak beams or by poorly arranged hangers or an insufficient number of them, if the belts are overstrained or crossed, or the pulleys not concentric on the shafts. These, and a legion of other intricate devices, by which so many power users contrive to let their hard-earned profits flow away at the bunghole, have got to be consigned to innocuous desuetude if real economy is going to be attained.

Just think of it! We will take a crossed belt, for instance, the two sides of it rubbing together most vigorously and exerting a frictional retardation, on each side, of many pounds; the running speed may easily be twenty-two hundred feet per minute, and a backward pull on each side of 7½ pounds may represent 1 h. p. How few men stop to think that for every horse power they throw away in that single belt they must pay from $100 to $300 per year! The writer spent a half hour's work some years ago to straighten out a twisted main belt and reduced the average power used by over 50 per cent. Crossed belts have to be used sometimes; but there is no excuse for them where they don't, and there is never any excuse for crossing a main belt.

There are, of course, many methods by which power may be distributed from a central source to the various power centres, but only a few of them are worthy of consideration. Belts are often the best transmitters for short spans; but it makes one weep to see power thrown away by conveying it over three or four different belts and as many shafts. Wire ropes, where a horizontal component of span of 100 feet or more can

be obtained,and where the load doesn't vary suddenly or need an especially steady speed, are often very satisfactory; but it doesn't seem as though wire rope transmission could ever have a very wide use in this country, because there are too many conditions necessary to its success, and Americans, above all things, do not like to be conditioned.

This latter remark applies also to the use of compressed air. Compressed air is used on a very large scale in Paris, a plant being now contemplated of 25,000 h. p., but they use reheaters in Paris to heat the air, just before using it, to a temperature of 300 or 400 degs. F., for this is the only way compressed air can be used economically. But if a man tried to talk "cook stoves" promiscuously distributed around a building, to the average American superintendent, he would very shortly reach the Bible conclusion that "all is vanity." Americans may be content to continue their old inconvenient methods; but every sign of the present times points to the fact that, as they do gradually cast them aside, they will insist upon replacing them with those that are, in every sense, convenient methods. It seems improbable, aside from its use for certain traction purposes, that compressed air will ever be used on a large scale in this country; but it does seem very probable that it will be largely used on a small scale, a scale sufficiently small to make it unnecessary to reheat it, or, in other words, to use it economically. We may briefly say in regard to these three methods of power distribution that, like everything else, they have their places, and, if certain "ifs" in regard to them are satisfied, will be highly successful in them. On the other hand, it must be admitted that, for this particular problem which we are now considering—the transmission of power to distributing centres—none of them is as universally applicable, and eminently suitable, in the vast majority of cases, as electricity.

NEWS AND NOTES

TEST OF INSULATED WIRES.

About ten months ago Messrs. Stone & Webster, of Boston, bought in the open market samples of wire of each of the makes which were approved by the underwriters and these they have allowed to lie in water, testing them from time to time to see which would hold out the best under these conditions. This form of test was decided on because it seemed to give nearer the conditions which were likely to be met with in practice in damp places than tests which had previously been made, allowing the wire to remain in the water for only a couple of weeks. These tests were made with the understanding that the names of the different makes of wires were not to be published without the consent of the manufacturers. The accompanying table shows the results, in which each wire is represented by a number. These wires have been all tested up to nine months, and wherever there is no reading recorded it means that the insulation was too low to be measured.

RESISTANCE IN MEGOHMS PER MILE.

No.	On Immersion.	After One Day.	One Week.	Two Weeks.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.	Six Months.	Seven Months.	Eight Months.	Nine Months.	Ten Months.	Eleven Months.	One Year.
1	5770	1790	1780	1203	1240	1032	1100	762	391	380	416	544	729			
2	4036	1526														
3	1542	.00706	.0505	.0879												
4	1171	582	122	326	.9											
5	4217	2500	482	238												
6	5357	2500	979	515	342	122	114	97	82.4	66	19					
7	1635	740	453	3.65	1.7											
8	267	162	523	.12	.04											
9	5384	2468	1870	535												
10	460	564	391	202	178	122	175	223	588	429	316	129	177			
11	2585	2407	1854	761	393	242	7	16	620	45	27	3.8	.2			
12	1738	1129	440	304	262	196	206	184	136	150	139	170	160			
13	902	899	916	567	587	378	360	296	208	174	152	126	155			
14	2380	1585	2120	812	699	469	466	388	328	317	314	301	32			
15	1904	318														
16	2510	2300	1690	1070	No Test		612	474	547	476	425	431	409	474	370	
3A	456	353	276	111	38	73	265	192	87	18	12					
15A	2970	2361	2116	1932	1544	832	451	365	26	6	12					

Note.—Wires allowed to remain in water for one year and insulation resistance measured at a temperature at 75 degs. F. at intervals indicated above.

RESULTS OF INSULATED WIRE TESTS MADE BY STONE & WEBSTER, BOSTON, MASS.

A FAIR is to be held in this city next February at Madison Square Garden in aid of the national home for disabled commercial travelers, their dependent families and their widows and orphans. The building is now partly finished, near Binghamton, N. Y, Mr. Alfred Chasseaud is manager of the fair.

OBITUARY

COL. JOHN JAMESON.

Col. John Jameson, general manager of the Union Subway Company, died of spinal disease at his home in Brooklyn on November 14. He leaves a widow, two daughters and a son. Col. Jameson was born in Albany in 1841. At the outbreak of the civil war he entered the volunteer service as a private in the Second Wisconsin Infantry. Transferred with his company to Battery A, First Wisconsin Artillery, in 1862, he rose to Senior First Lieutenant. Serving through the war, he was mustered out on September 5, 1865. Soon after he became route agent of the United States Postal Department, and was advanced until in 1884 he was appointed general superintendent of the railway mail service by President Arthur. Declining an appointment as major and paymaster in the regular army, he continued in the mail service until 1887, when he resigned to accept a post in the management of the company then engaged in the construction of the electrical subways in New York. He had gained a reputation as an expert in this line. He was a director in the Union Subway Construction Company, the Consolidated Telegraph and Electrical Subway Company, the New York Telephone Company and the American Telephone and Telegraph Company at the time of his death.

JOHN CONOVER HINCHMAN.

Mr. John Conover Hinchman, of Summit, N. J., died in the Orange Memorial Hospital, Orange, on November 14, after a lingering illness. He was born in 1820 at Belmont Hall, his father's home in Schooley's Mountains, and was educated at Lafayette College. He became interested in telegraphy, and for a number of years he was associated with the Western Union Telegraph Company. In 1875 he was promoted to the place of superintendent of the Eastern Division, embracing the New England States and the British provinces. On reorganization of the company in 1881, under General Eckert, Mr. Hinchman resigned, but later accepted another place and was

connected with the company at the time of his death. He leaves a widow and two daughters.

SOCIETY & CLUB NOTES

THE AMERICAN SOCIETY OF CIVIL ENGINEERS IN ITS NEW HOME.

On Wednesday, November 24, the American Society of Civil Engineers formally took possession of its new home, the event being celebrated by a house warming, a large number of members and invited guests taking part in the celebration. Addresses were made at the meeting in the afternoon by Benjamin Harrod, president of the society; Bishop Potter, Major General Geo. S. Greene, U. S. A.; Dr. J. G. Schurman, president of Cornell University, Mr. Joseph Choate and others prominent in engineering and other professional circles. The house was beautifully decorated and the proceedings in the evening were enlivened by music and the serving of a supper by Mazzetti.

The society's new house is located at 220 West 57th street, near the Carnegie Music Hall, and opposite the Fine Arts

THE NEW HOME OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

Building, and covers a plot 50 by 110 feet. It is a handsome example of French renaissance in Indiana limestone, richly carved, and is a notable addition to the ever-increasing list of New York's handsome buildings. It was designed by Mr. C. L. W. Eidlitz.

On the first floor are the reception room, coat room and the offices of the secretary, as well as a large room intended for a convenient meeting place for members for social as well as business intercourse. On the second floor are the reading room and auditorium, the latter having a seating capacity of over 400. On the third floor space is reserved for a museum and model room; the clerical force also has offices here. The fourth floor is used exclusively as a stack room, where the books have a permanent place. An electric book lift runs to the reading room on the second floor. The stack room has a total capacity of over 100,000 volumes. The stacks are similar to those used in the new Library of Congress at Washington. In the basement are janitor's quarters and large storage and publication rooms. The building is steam heated throughout and lighted by electricity from a Crocker-Wheeler plant, the energy for which is provided by two gas engines of 25 h. p. each.

The society is purely a scientific body and the building is in no sense a club house. Its use is exclusively for the advancement of the science of engineering, and it is the first building erected in America to be devoted to the exclusive purpose just named.

The American Society of Civil Engineers, we may add, is the oldest technical engineering association in America. Its membership of 2,100 is composed of several grades, to which admission can only be obtained after most rigid investigation.

The papers presented to the society, of which over 800 have been published to date, have covered every branch of engineering, general and specific.

The officers of the society at the present time are: President, Benjamin M. Harrod, New Orleans, La., chairman of the Mississippi River Commission. Vice-presidents: Wm. R. Hutton, consulting engineer, New York City; P. Alexander Peterson, Montreal, Canada, chief engineer Canadian Pacific Railroad; Colonel Geo. H. Mendell, San Francisco, Cal., corps of engineers, U. S. A.; John F. Wallace, Saltville, Va., late chief engineer Illinois Central Railroad. Secretary, Charles Warren Hunt, New York City; treasurer, John Thomson, mechanical engineer, New York City.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION.

As already noted, the electric transmission companies of the Pacific coast have organized an association under the name of the "Pacific Coast Electric Transmission Association." The following companies are members: Blue Lakes Water Co., Blue Lakes City, Cal.; The Big Creek Power Co., Santa Cruz, Cal.; Southern California Electric Co., Redlands, Cal.; Sacramento Electric, Gas and Railway Co., Sacramento, Cal.; Central California Electric Co., Sacramento, Cal.; San Joaquin Electric Co., Fresno, Cal.; Power Development Co., Bakersfield, Cal.; Portland General Electric Co., Portland, Ore.; Nevada County Electric Power Co., Nevada City, Cal.; San Gabriel Electric Power Co., Los Angeles, Cal.

An application for membership has been received from "The Big Cottonwood Power Co.," of Salt Lake City, Utah.

The association was organized in San Francisco June 8, 1897, and the following officers elected: C. P. Gilbert, president, Sacramento Electric, Gas and Railway Co.; H. H. Sinclair, vice-president, Southern California Power Co.; Robert McF. Doble, secretary and treasurer, Blue Lakes Water Co. W. Frank Pierce, Blue Lakes Water Co.; J. J. Seymour, San Joaquin Electric Co., Executive Committee.

A meeting was held in Santa Cruz August 17 and 18, and at Sacramento October 20 and 22. At Santa Cruz the subject of "Insulators" was discussed from papers read, and at Sacramento "Lightning Protection," and the "Hydraulics of Power Installations." The next meeting will be held in San Francisco February 15-18, 1898.

The "Journal of Electricity," of San Francisco, has been selected as the official organ for the publication of papers read before the association.

The president, Mr. C. P. Gilbert, was for a number of years prominently connected with "The Association of Edison Illuminating Companies," being at that time the general manager of the Edison Illuminating Company, of Detroit, Mich.

BOSTON ELECTRIC CLUB had a good meeting on November 5, when sixty members and friends enjoyed a banquet at the United States Hotel. The guests of the club that night were W. J. O'Leary, C. P. Bruch and W. W. Neifert, all of whom spoke. A most enjoyable evening was spent.

THERMO-ELECTRIC PROPERTIES OF SOME LIQUID METALS.

An abstract of an interesting paper on this subject by Mr. William Beckit Burnie is published by the Chemical Society in their "Journal." The author thermo-electrically compared tin, lead, bismuth and mercury with copper, the tested metal being contained in a hard glass tube, so that the observations could be pushed to temperatures considerably above those of the melting metals, and the changes in the thermo-electric properties during the process of melting observed. About the melting point, a small variation of temperature produces a considerable change in the direction of the thermo-electric curve. The effect is smallest with lead, with tin it is larger, and with bismuth it is very remarkable, that metal changing during melting from an exceedingly active thermo-electric metal to one very similar to lead in its thermo-electric properties. With mercury also a great change takes place at the melting point.

PERSONAL

ALEXANDER HENDERSON.

Alexander Henderson.

The recent issuance of the rules of the New York Fire Department have directed no small amount of attention to that branch of the public service of New York City and its officials. The Chief Inspector, Mr. Alex. Henderson, has come to occupy a place of importance and responsibility in the community that marks the extent to which electrical work has already come under the supervision of one central authority representing the city government. It is early yet to determine the full scope of the new departure, but the intense interest that is manifested in other American cities as to the new rules and regulations of the Department is a striking evidence of the effect that such an example must have. The efforts to raise the standard of wiring and general construction are part of electrical history; the position now taken by the municipal authorities opens up a further chapter of advance toward perfect safety in such work.

Mr. Henderson has the advantage of a close practical knowledge of the art. He is a Scotchman by birth, having been born at Edinburgh in 1859. Before he was 21 he had traveled extensively, visiting Germany, Spain, Italy, Russia, Turkey, Egypt, the West Indies, Africa, the United States, Canada, India, China and Australia. In Turkey, in 1878, he witnessed some of the most stirring events of the war of that year. Before the end of 1881 he had been twice around the world, and tiring of travel, settled down in New York in the employ of the old Weston Electric Light Co. in their Centre street station. He next became connected with the Brush Electric Illuminating Co. and assisted in the construction of the masts on Madison Square, since removed. He was also actively connected with much of the early electric lighting line construction throughout the city. In 1883 he went West in the parent Brush Company's interests, and represented them as superintendent of construction in several parts of the United States, Canada and Mexico for about eight years. Returning to New York in the fall of 1890, he was appointed Chief Inspector for the Manhattan Electric Light Co., but again resumed construction work, etc., outside the city. In November, 1895, he was appointed the first Chief Inspector of the Bureau of Fire Alarm Telegraphs and Electrical Appliances of the Fire Department of New York. As has already been intimated, the position has grown very rapidly in importance, and through Mr. Henderson and his large staff of assistants the city now watches with vigilant eye all the electrical work that goes on within its borders, with an inspection system that aims at thorough completeness. It will be remembered that extended editorial comment on the latest rules of the Bureau was made recently in the pages of this journal. Mr. Henderson is well known as an indefatigable official, anxious to secure the highest efficiency, and in spite of the difficulties of the work he is very popular throughout the field of supervision. He is regarded as the champion globe trotter of the profession; and perhaps the warm welcome extended to him by old friends everywhere in "God's country" is in a little measure due to the marvelous collection of traveler's tales which he can regale an audience with.

MR. JOHN W. SANKEY, managing partner of the house of Joseph Sankey & Sons, Bilston, Staff, well known English manufacturers of iron stampings for all classes of electric light and power apparatus, is at present on a trip through this country, where he is finding much of interest, mechanically and electrically.

MR. W. M. MURPHY, of the Dublin United Tramways Company, since his return home from the U. S. A., says that he and his associates had recently spent $750,000 in this country, and had saved from $100,000 to $150,000 by their personal contact with the manufacturers.

PROF. ELIHU THOMSON has consented to contribute to the pages of the "Youth's Companion," of Boston, on technical topics. That popular paper could not have made a better choice, and it is to be hoped that Prof. Thomson will be able to find many opportunities for the exercise of his great powers of direct and simple elucidation.

MR. R. W. POPE, secretary of the American Institute of Electrical Engineers, has been confined to his home by a very severe attack of rheumatism, but will, it is hoped, be restored to full health and strength this week.

MARRIED

LAWTON—BOARDMAN.

Mr. Burton L. Lawton, treasurer of the Connecticut Telephone and Electric Co., Meriden, Conn., was married on Thursday, November 18, to Miss Grace W. Boardman, of East Haddam, Conn. Miss Boardman is the daughter of Norman A. Boardman, of the firm of Luther A. Boardman & Sons, Meriden, Conn., one of the oldest concerns in the country manufacturing Britannia ware.

LEGAL NOTES

THE BELL TELEPHONE DECISION.—REMARKABLE STORY OF A "LEAK" IN THE U. S. SUPREME COURT.

BEHIND a $30,000 damage suit on file in the Supreme Court of New York County lies a story, says the New York "Journal," of how the Supreme Court of the United States lent itself unwittingly, through the dishonesty of a clerk, to a deal in which a coterie of lobbyists cleared up over $100,000 in Wall street.

It clears up the mystery of the tip which went out to a chosen few on May last to buy Bell Telephone stock. It shows how the Supreme Court's decision in favor of the Bell Company became known two days before it was handed down, and how those who "were on the inside" profited, wrangled, fell out and sued.

One evening, while the decision of the Supreme Court in this celebrated case was pending, a merry party sat about a table at Chamberlin's, in Washington. There were Joe Rickey, former Congressman from Missouri, and inventor of the insidious drink which bears his name; Phil Thompson, of Kentucky, a prince among lobbyists; Edwin Barbour, of Virginia, now of New York City, and J. R. McMurren, a lieutenant of Phil Thompson.

During the course of the evening the conversation touched upon many matters that were then engaging the attention of Congress or different departments of the government. McMurren at length engaged Barbour on the subject of "a good thing." Barbour was at that time senior member of the firm of Edwin Barbour & Co., bankers and brokers, at No. 6 Wall street, this city. He had always had money, and all the evidences of prosperity, and was the relative and associate of more than one Senator and high government official.

"I'll tell you what I'll do, Barbour," McMurren finally said. "I'll furnish you with the full text of the decision of the Supreme Court in the Bell Telephone case if you'll agree to buy or sell 1,000 shares, according to what the decision may be, and divide the profits on a basis of two-thirds for us and one-third for yourself."

"But how can you get the decision before it's handed down?" asked Barbour, incredulously.

"Why, easy enough," answered McMurren. "Phil Thompson can get it. He's got a clerk in the Supreme Court who furnishes him with anything of that sort that he wants."

This clear explanation tempted Barbour. He hesitated, pondered, then agreed, and, before he and McMurren separated

had signed a contract. This contract embodied, in more elaborate language, exactly the proposition which McMurren had first put to Barbour—that he should, upon being furnished the court's decision, two days before it was handed down, buy or sell 1,000 shares of Bell Telephone stock, and, in the event of a profit, give McMurren two-thirds and retain one-third for himself. No names were mentioned in this contract save those of Barbour and McMurren, but Barbour understood that Phil Thompson was to receive one-third as his share.

Early in May McMurren put in an appearance in Wall street. He called upon Barbour and assured him that the decision would be forthcoming as promised, and explained that there was no possible chance of losing on the deal. On May 8 McMurren was at Barbour's office again, this time with the promised information. The decision, he announced, would be in favor of the Bell Telephone Company. Phil Thompson, he declared, had read a copy of the decision, and knew its full text.

Thompson was called up on the long distance telephone and confirmed the statement of McMurren. Barbour was further encouraged to fulfil his contract by the statement that several prominent operators, among them James R. Keene, would handle large blocks of the stock upon the same terms as himself.

Sure enough on May 10, two days later, the decision was handed down. McMurren's prediction was fulfilled. By the decision the Bell Telephone Company was presumed to continue the control of the telephone for eleven years—seventeen years from the date of the last patent, which was granted in 1891. The case had been in the courts for a long time. The government sued the Bell Telephone Company to secure the cancellation of the patent issued to Emil Berliner for a transmitter, upon the result of which depended the continuance of a telephone monopoly. The suit was begun six years ago, in the United States Circuit Court for the District of Massachusetts. On January 3, 1895, Judge Carpenter, then presiding in that district, decreed a cancellation of the patent. The Bell Company took the case to the Court of Appeals for the First Circuit, which, on July 14, 1895, in an opinion read by Judge Putnam, reversed the Circuit Court, with instructions to dismiss the bill. From that decree the United States appealed to the Supreme Court.

This final settlement of the case, therefore, meant a great movement in the company's stock in one direction or the other, and splendid profits for those speculators who were on the right side. When the decision became officially known in Wall street the stock began rising. It went up 8 points in one afternoon. Day by day it rose, finally scoring an advance of about 30 points before it stopped.

Shortly after the announcement of the decision McMurren called on Barbour and asked for his two-thirds of the 1,000 share deal provided for in the contract. Barbour declared that he had become afraid of the deal and had not bought the 1,000 shares. There was an animated discussion. McMurren exhibited checks and stocks which he said represented $10,000 which James R. Keene had just given him as two-thirds of the profits in the stock, which he had bought upon the same information furnished Barbour. But Barbour insisted that he had not traded on the "tip."

The next chapter was the filing of a suit by Robert L. Stanton, whose offices are in the Mills building, on behalf of McMullen, claiming $30,000 damages from Barbour. In this suit and in the answer, which has just been filed by J. W. & C. W. Ridgway, of No. 100 Broadway, for Edwin Barbour, the confirmation of this story is found.

Mr. Barbour himself, when seen at No. 45 Broadway, admitted that the suit was brought about as described, but declined to talk about the matter. Mr. James R. Keene did not deny the part ascribed to him, but said that it was a matter which concerned one of his clients, and which he could not, therefore, discuss. (Mr. Keene has since denied his share in the transaction.)

The revelations made by this suit may explain other great raids on the street just preceding the announcement of court decisions affecting the value of listed stocks. The recent decision of the Court of Appeals in the case of the Manhattan Elevated Railroad may have "leaked" in a similar manner. This is merely one instance out of a great number that might be cited, but it serves to show by what devious methods some people seek to beat the fierce game which Wall street supports.

HOPE ELEC. APPLIANCE CO. VS. RUSSELL ELEC. MFG. CO.

At Providence, R. I., on November 17, a hearing was held before Judge Brown in the United States Circuit Court in the case of the Hope Electric Appliance and Manufacturing Company against the Russell Electrical Manufacturing Company and others. Henry Marsh, Jr., appeared for the complainant and the defendant was represented by Van Slyck & Mumford.

The respondent company moved that the bill of complaint brought against it be dismissed, on the ground that the treasurer had not been served with a subpœna. The others in the case, John Heathcote and Charles Ward Russell, also moved that the complainant, which is a Maine corporation, be required to furnish surety for costs. Both motions were granted.

PHILADELPHIA GAS LITIGATION.

A special dispatch from Philadelphia of November 13 says: The legal battle to restrain the mayor from surrendering the control of the gas works to a private corporation for thirty years was begun in the courts to-day. A formal application for an injunction to prohibit the contract was made by George Tucker Bispham and other counsel representing a body of citizens. The bill was amended to allow John M. Campbell to become a party to the suit as a holder of one of the loans of the city issued for the extension of the gas works in 1868. The loans expire in 1899.

The contention is raised that the terms of the contract with the United Gas Improvement Company will impair the city's obligations to holders of the gas loans under the conditions of their issue.

A second suit in equity against the mayor, director of public works and city comptroller, to restrain the lease, was filed this afternoon on behalf of the J. W. Baker syndicate, which made a flat offer of $10,000,000 to the city for the lease on the same terms granted to the United Gas Improvement Company, the offer having been ignored by councils and the mayor.

THE STOCK MARKET

TRADE STEADY, STOCKS DULL.

Reports of trade and railway earnings throughout the country continue good, while it seems likely that the grain exports last week break the record of any single week in the history of the country. The stock market has, however, continued dull and languid, barely a million shares being dealt in. A change for the better is expected on a higher range of prices, subject only to doubt as to what Congress may do when it meets. The present Thanksgiving week being a holiday spell, will probably see continued quiet. There is a large demand for good bonds.

Very little activity is shown in electrical stock. Western Union, on less than 10,000 shares, fluctuated around 86½ to 87c. General Electric was hardly in evidence, with only 1,688 shares at about 32½. American Bell Telephone is very quiet, but pointing upward again to the 270 mark. New York Metropolitan Street Railway stock is strong on reports of good earnings. An issue is being offered by Sutro, Scholle & Co., of this city, of $1,315,000 5 per cent. 30-year bonds of the Akron Street Railway & Ill. Co., where a consolidation has been effected.

Copper is easier, owing probably to small exports, and the price is 10.75 cents. Lead is 3.75. Steel rails, heavy, Eastern mill, are stronger at $19.50.

REPORTS OF COMPANIES

IMPORTANT DEAL TO EXTEND THE WALKER CO.'S OPERATIONS.

A transaction has just been closed in Cleveland, by which Eastern capitalists, including ex-Governor Flower, of New York, J. W. Hinkley, Anthony N. Brady and Mr. Belmont, of New York, have acquired the entire property of the Walker Company, including all the stock and bonds. The Walker Company has extensive factories and foundries in Cleveland, covering twenty acres, as well as a large factory at New Haven, Conn.

The company was engaged originally in building and equipping cable railways and manufacturing other heavy machinery. For the last two or three years the company has been

building very large types of electric railway and electric lighting apparatus, the design and invention of Prof. Sydney H. Short. It has equipped many large street railway companies on this continent and several steam railways, in addition to selling great quantities of machinery in foreign countries. It also equipped the new Astoria Hotel in New York with the largest isolated electrical plant in the world.

The gentlemen who have made the purchase have been stockholders in the company for a short time, but were in a minority. They now become the sole owners of the property. They are also interested in many large street railway systems and electric lighting companies in many of the principal cities and are, therefore, in a position to turn over to the Walker Company a vast amount of business. The deal now closed has been in progress for a long time past, and will, it is said, insure the continued independence of the company, while enabling it to assume the direct responsibility for much more business than it has hitherto been able to grapple with.

TRADE NOTES & NOVELTIES

KEYSTONE PORTABLE MILLIAMMETERS FOR ALTERNATING CURRENT CIRCUITS.

We are in receipt of a communication from the Keystone Electrical Instrument Company, of Philadelphia, in which they announce the above novel instrument. They state that something over a year ago they received a request from the Committee on Meters of the American Electro-Therapeutic Association to design and submit for test a portable milliammeter for use on the sinusoidal alternating and Faradic current circuits. The solution of the voltmeter problem was quite simple and the requirements were fully met by their portable voltmeter for direct and alternating current circuits, but the design of a portable milliammeter for this class of work presented a very novel problem which had never been successfully solved. After several months' careful experimenting they succeeded in perfecting an instrument which practical test proved to be eminently satisfactory.

The report of the Committee on Meters presented at the annual convention of the American Electro-Therapeutic Association, held in Harrisburg last September, contained an unqualified approval of this instrument, and as the result of their tests and investigation recommended it to the profession.

In the course of the experimental work a number of tests were made with the milliammeter and some data obtained on commercial apparatus which heretofore had only been obtainable by calculation. Among other things tested was the current consumption in the primary coils of transformers when the secondary was on open circuit, thus determining directly and without calculation the idle losses in the transformer system. The result of the test showed the very great difference in what might be termed the idle efficiency of transformers of various makes, and further showed a marked difference between new transformers and transformers in which the iron had aged as the result of several years' continuous use.

This whole question is one of more than passing interest to central station managers who employ the alternating current, and careful tests of the amount of current required to energize the primary coils of transformers when the secondary is on open circuit would, no doubt, lead to a more careful selection of transformers, and the replacing of many which have outlived their usefulness. Direct reading in such matters is far superior to calculation, and we have no doubt that many stations would discover unexpected losses by making a series of tests on the transformers now on their lines.

The instrument itself is neatly designed and mounted in a polished mahogany case, its calibration carefully made and its indications may be relied upon as perfectly correct.

LIBERTY LAMP COMPANY.

The Liberty Lamp Co., having its factory in the Harcourt Building, Irvington and Harcourt streets, Boston, is a concern recently organized for manufacturing high-grade incandescent lamps.

Mr. Eugene McOuat, formerly superintendent of the well known Beacon Lamp Co.'s factory, which was located in the same building, is the chief stockholder in the new company and is having a fine working plant installed. Mr. McOuat has had a long and varied experience as assistant to several of the best known electrical inventors and engineers.

For years he had control of the Beacon Lamp Works, both in Boston and in New Brunswick, N. J. He ranks high as a lamp maker, and with the assistance of a corps of first-class experts, including Mr. William W. Scott, who, too, has had several years' experience, success is bound to be achieved.

AUTOMATIC TIME SWITCH.

A DEVICE for automatically turning off and on the lights in a store has recently been perfected, called an automatic time switch. The Western Electric Co., of Chicago and New York, are the agents for the United States.

This switch is a double pole, 30 ampere, snap switch, with a capacity up to 220 volts, arranged in combination with a clock. Any person desiring his lights to burn until 12 o'clock, or any specified time, sets the clock as he would an alarm clock, and turns on the lights. As soon as the time indicated by the little pointer on the dial of the clock is reached the clock automatically releases a catch and the lights are turned out. The same device is used for turning on lights.

Where central stations are selling light by contract to burn to specified hours these automatic time switches can be installed by the electric light company and the inspector carry a key to the switch. By this means the company can be assured of having the light turned off at the time specified in their contracts with customers. If the customer has a meter and desires to keep his store illuminated until a certain hour he can with perfect assurance lock his door and leave the automatic switch to take care of the lights, knowing that he is not dependent upon the service of any watchman, and that his lights will not be taking current and a bill run up on account of lack of attention.

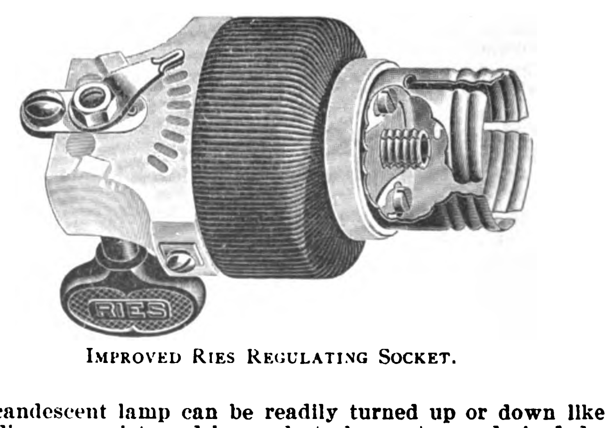
THE OTTO ELECTRIC CO.

This company has been formed for the purpose of doing general electrical work, but devoting its attention particularly to the installation of electrical apparatus for physicians, surgeons and dentists. It has a well equipped shop, in which it is prepared to do model work of every description for inventors, patent attorneys and amateurs.

Mr. Otto Rothenstein, the electrician of the company, has had an extended experience, having been connected with some of the largest electrical companies here and abroad. The offices of the company are in "Times" Building, New York.

THE RIES REGULATING SOCKET.

THE McCay-Howard Engineering Co., No. 106 East German street, Baltimore, Md., are manufacturing a "Ries Regulating Socket" for the purpose of regulating incandescent lamps on alternating circuits. They have vastly improved the details of the construction of this socket, using porcelain entirely in the construction, and claim to have produced the most perfect alternating socket ever built. By means of this socket



IMPROVED RIES REGULATING SOCKET.

an incandescent lamp can be readily turned up or down like an ordinary gas jet, and be made to burn at any desired degree of brilliancy, from a barely perceptible glow, consuming but one-tenth of the normal current, up to full candle power of the lamp.

The socket consists simply of a coil wound in a novel way around the core; each core has a complete magnetic circuit giving a very economical socket, and produces a kicking effect

on the main circuit, thereby reducing the voltage of the lamp and effecting a saving in proportion to the light.

The socket, which, by the way, has no wasteful resistance to consume the current, is adapted to lamps of any voltage and candle power within its range, and thus places the incandescent lamp on a par with gas. It affords the consumer a successful, practical and economical method of controlling the amount of light given by the lamp, and effects a material saving, both in the cost of the current and in the life of the lamps. There is no doubt that the field of domestic electric lighting, although by far the largest and most profitable, and which has scarcely been touched by the central station man, will now receive a tremendous development, as the numerous inquiries, not only from the central station man and supply men, but from the general public as well, indicate.

The accompanying engraving shows the method in which the socket is built, and the large sales now being made of this socket insure the manufacturers a prompt return for their enterprise.

CUTTER CIRCUIT BREAKERS IN BOSTON.

Mr. B. B. Hatch, engineer of the electrical construction division of the Public Buildings Department of the City of Baston, has written as follows to the Cutter Electric and Mfg. Co., under date of November 8: "It gives me great pleasure to notify you that the special double pole circuit breakers, which you built for the Boston City Hospital switchboard, have proved their value under a rather unexpected test. Last Wednesday evening one of our men accidentally dropped his wrench across the bus-bars of a large tablet board, completely short circuiting one side of the three-wire system, which is balanced by a 5 k. w. motor generator. The circuit breaker, which was set at 300 amperes, opened instantly, even before a 50 ampere fuse on the 5 k. w. unit could act. Had there been no circuit breaker we should have lost our motor generator, and consequently the whole system. No damage resulted to the 5 k. w. unit, which had to deliver current sufficient to open the circuit breaker, and we suffered no interruption of service except on this one feeder. Your circuit breaker is all right."

ADVERTISERS' HINTS

THE WESTON ELECTRICAL INSTRUMENT CO., 114 William street, Newark, N. J., advertise a line of cheap but excellent switchboard instruments for direct current circuits, which they designate as "Round Pattern," type "F." They are particularly suited to isolated plants and feeder circuits in railway and power plants.

THE CHICAGO ARMATURE CO.'S shops at 15 and 17 North Canal street, Chicago, are always open. Commutators are made and refilled and armature winding done for any system.

THE HART & HEGEMAN MFG. CO., Hartford, Conn., claim the highest quality for their switches, low prices and immediate shipments. Their illustrated catalogue contains full particulars regarding their switches, wiring diagrams, etc.

THORBURN REID, consulting engineer, 120 Liberty street, New York, will undertake the design of dynamos, motors and transformers and guarantee performance. Also the design and supervision of light and power plants.

THE ELECTRICAL EXHIBITION CO., 15 Cortlandt street, New York, say the electrical exhibition in Madison Square Garden in 1898 will present the grandest aggregation of electrical appliances ever shown under one roof. It is to be an object lesson to the public in applied electricity and a post graduate course for the engineer.

THE C & C ELECTRIC CO., 140 Liberty street, New York, advertise dynamos and motors of the highest attainable efficiency, the latest approved type and for all purposes.

THE GENERAL ELECTRIC CO. advertise their pocket testing instruments of the Thomson inclined coil type. They have many advantages, among which may be mentioned the small size and low price.

CHAS. E. GREGORY CO. are now in their new quarters at 58-62 South Clinton street, Chicago. Their bargain sheet of dynamos, motors, arc lamps, transformers, instruments and supplies may be found of value to prospective buyers.

THE CHICAGO EDISON CO., 139 Adams street, Chicago, offer a large variety of dynamos, engines, boilers, heaters and pumps.

THE WHEELER REFLECTOR CO., Boston, Mass., under the title of the "Sun and Its Proxy," recommend the use of their reflectors when the sun fails. They carry over 200 styles.

THE KEYSTONE ELECTRICAL INSTRUMENT CO., Ninth street and Montgomery avenue, Philadelphia, have recently bought out a switchboard potential indicator designed to meet that class of trade requiring reliable and durable instruments at low prices.

THE SWARTS METAL AND REFINING CO., 21 and 23 North Desplaines street, Chicago, wish to sell high grade motor Babbitt metal, bar and wire solder, and cotton waste at low prices and in exchange will take scrap copper wire and brass, allowing full market value.

THE WESTERN ELECTRIC CO., Chicago and New York, advertise themselves as the great source of supply for orders large and small for electrical supplies and machinery.

THE OKONITE CO., New York, apropos of the season say: "Use Okonite wire and you will always be thankful." Their Thanksgiving turkey this year is a "bird."

THE ANCHOR ELECTRIC CO., 71 Federal street, Boston, Mass., in advertising the "Anchor" switches, call attention to the ease of operation, the quick break and the small liability of breaking under the most exacting conditions.

A. & J. M. ANDERSON, 289-293 A street, Boston, Mass., are advertising the Anderson quick-break service switch, with fuse terminals and "Ætna" cover, and the Anderson "Ætna" outlet insulators for use at free ends of iron interior conduit.

NEW ENGLAND NOTES

WM. L. WALKER & CO. have removed to 174 Summer street, Boston, Mass., where they have larger offices than heretofore, with a large wareroom, which is devoted to showing goods. This company has recently put on the market the safety electric gas lighting burner, which was illustrated and described in The Electrical Engineer of October 21.

THE WHITLOCK COIL PIPE CO., Elmwood, Conn., have the order to install a 3,000 h. p. American Heater in the Kings County Electric Light and Power Co., Brooklyn, N. Y., about December 1. They are also shipping a 2,000 h. p. American heater to the Worcester Street Railway Co.; two 1,200 h. p. heaters to the Bass Foundry and Machine Works, Fort Wayne, Ind., for the Arkwright Mill, Fall River, Mass. The Whitlock Coiled Pipe Co. report having received within the past 30 days orders for about 12,000 h. p. of their American feed water heaters of various sizes.

P. R. WAGOR CO., Springfield, Mass., report that the large demand for incandescent lamps has greatly stimulated the use of wire guards of all kinds of which they are manufacturers. Inquiries for their catalogue and many orders are now keeping that department of their factory busy. They solicit correspondence from dealers and others using wire guards or in the wire line and will also manufacture special design in quantities to order.

W. S. HILL ELECTRIC CO., of New Bedford, Mass., have shut down Thanksgiving week for an overhauling of the boilers and engines of its plant. Several new pieces of machinery will be added.

THE WILKINSON MANUFACTURING CO., manufacturers of mechanical stokers, Bridgeport, Pa., have installed a 3,500 h. p. mechanical stoker in connection with the electric plant at the new Astoria Hotel, New York City.

WATERBURY, CONN.—The new boiler house which is being erected by the Waterbury Buckle Company, will have a roof of corrugated iron, supported on steel trusses. The building is 36 feet wide and about 48 feet long, having brick side walls. Every effort is being made to make this building fireproof. The steel work is being furnished and erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

THE CONNECTICUT ELECTRIC AND TELEPHONE CO., Meriden, Conn., have installed a 1,000 drop switchboard and 1,000 telephones for the Mutual Telephone Exchange at Des Moines, Ia. This exchange is the largest independent one west of the Mississippi. The Connecticut Electric and Telephone Co. are putting in also a 400 subscriber exchange at Oswego, N. Y. They report their works very busy.

JAMES HUNTER MACHINE CO., North Adams, Mass., have recently placed in the Edison plant at Paterson, N. J., also in the New London, Conn., Electric Light and Power Co.'s plant, power transmission machinery consisting of shafting, friction clutch pulleys and friction clutch cut-off couplings. This firm manufacture the most up to date specialties in friction clutch pulleys, cut-off couplings, shafting hangers and pulleys, safety stop for elevators, etc. The James Hunter Machine Co. have been installing their goods in many electric plants throughout the country and report their works busy in this particular department.

WESTERN NOTES

THE "AMERICAN BUILDER," one of the handsomest and best papers of its class, offers a list of 100 of the leading periodicals of America free to new subscribers. Particulars, together with specimen copy, may be had by addressing the "American Builder," 184 La Salle stret, Chicago.

AHLM-EDWARDS ELECTRIC CO. are finding business very brisk and report that their factory is actively engaged filling orders.

FRONTIER IRON WORKS.—Mr. G. A. True, formerly with the Whiting Foundry Equipment Co., of Chicago, has recently accepted a prominent position with the Frontier Iron Works, of Chicago.

MR. W. J. McCONNELL, the Western representative of The Electrical Engineer, has opened an office at 1404 Fisher Building, Chicago, opposite the Monadnock, where The Engineer office was formerly situated. He will be glad to receive all friends of the journal there, and we bespeak for him throughout the West the courtesy that has always been so freely extended to this paper and its representatives.

STROMBERG-CARLSON TELEPHONE CO., Chicago, have recently completed telephone exchanges in the following cities: Adrian, Minn.; Chatfield, Minn.; Wayne, Neb.; Huntsville, Tex.; Albany, Tex.; Sheldon, Ill.; Gilman, Ill., and Rockville, Ind. Business continues prosperous with them and they have been obliged to double their capacity within the last two months.

CHARLES E. GREGORY CO. have just moved into their new quarters, occupying the whole handsome building at 58-60-62 South Clinton street, Chicago. Their large and growing business has necessitated this move. They carry a full line of new and second-hand dynamos and motors.

ST. PAUL, MINN.—The supervising architect at Washington has called for bids for wiring the St. Paul public building, bids to be opened November 30.

THE DIAMOND ELECTRIC CO., of Peoria, Ill., report an unprecedented demand for their transformers and meters.

CHICAGO ARMATURE CO. are busy working night and day filling orders for repair work. They are unusually well equipped for quick repairs.

MR. H. B. CUTTER, of Philadelphia, favored Chicago with a one day's visit this week.

AMERICAN ELECTRIC TELEPHONE CO., of 171-173 South Canal street, Chicago, were the most successful competitors, we are informed, at the recent Tennessee Centennial Exposition, receiving the highest award for meritorious apparatus in the line of telephones and switchboards. This follows up the success of the company at the preceding Atlanta Exposition, where a highest award was also secured. The American Company are to be congratulated on their enterprise and its reward.

ROTH BROS. & CO., 32 and 34 Market street, Chicago, are doing a large business in their new multipolar dynamos and motors. They are duplicating their capacity and have recently made a large shipment of dynamos and motors to Mexico.

NEW YORK NOTES

"AMERICAN MACHINIST" has celebrated its twentieth anniversary in the November 4 issue, which devotes 14 pages to an interesting illustrated account of the career of the paper, its past and present methods, personnel of business and editorial staffs, resources in art department, etc. The "Machinist" sets its standard very high and lives up to it in a most creditable and successful manner. It is to be congratulated upon the numerous evidences presented of prosperity and progressiveness.

SANDERSON & PORTER, 31 Nassau street, New York City, have just closed a contract for a power transmission plant from Bethel to Randolph, Vt., a distance of eight miles, at 6,000 volts. The generator will be 150 k. w., of the Westinghouse inductor type, and the current at Randolph will be stepped down for distribution at 2,000 volts. The plant is to be running in January.

MR. R. SCHMIDT, 253 Broadway, New York City, has been appointed sales agent of the Warren Electric & Specialty Company, Warren, Ohio. This company manufactures high-grade incandescent lamps, and is independent of the lamp manufacturers' combination. Mr. Schmidt will keep on hand a stock of lamps, and will be able to guarantee immediate delivery of all orders. He is ready to furnish samples to all responsible buyers without charge.

EDWARD R. KNOWLES, 150 Nassau street, New York, may be consulted on all matters relative to electrical engineering in its several fields.

GENERAL ELECTRIC COMPANY during the months of June, July and August received orders for 278 generators, aggregating nearly 14,000 k. w. for lighting purposes alone.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXIV. DECEMBER 2, 1897. No. 500.

ELECTRIC LIGHTING

THE RAND CENTRAL ELECTRIC WORKS.

THE rapid development of the Transvaal gold mines on the Witwatersrand has brought about a considerable increase in the motive power required for the various mines, which extend for a distance of 25 miles east and west of Johannesburg, in the Transvaal. It is estimated that at present about 20,000 h. p. in engines is installed along these mines. When one considers that these engines represent an aggregation of small units, and that some of them are by no means of most recent type, it will be readily understood that the average efficiency of the steam engines of the Rand is far from the maximum. The richest companies have already replaced their old and scattered plants by groups containing modern steam engines of larger power, and consequently more economical. But, nevertheless, the quantity of coal consumed in the various mines is enormous. This enormous consumption of coal has in fact frequently caused a blockade on the railroads around Johannesburg, and several mines have been forced to shut down temporarily for lack of coal. Besides this, some companies, having no contracts with the Netherland Railway, have suddenly had their provision cut off since the appearance of the rinderpest. In addition the freight rates are known to be very high on general merchandise and on coal in particular.

This combination of conditions some time ago gave rise to the proposition to establish not far from the Rand a central power station capable of furnishing electric energy to the various mines for hauling and lighting. The preliminary plans were discussed in 1894, and the first proposition was to utilize the falls of the River Vaal, but Mr. Singels, director of the Rand Central Electric Works, finally rejected this plan, owing to the lack of water in the dry season. The station was finally located on the property of the Brak-Pan mine, owned by the Transvaal Coal Trust Co., close to the mine shaft.

In the meantime the new company had obtained from the government of the Transvaal Republic a franchise for lighting Johannesburg and transmitting power by overhead wires to the Witwatersrand. The contract with the coal company binds the latter to furnish the Rand Central Electric Works all coal required by it for a period of fifty-five years.

The plans for the station were rapidly drawn up, and work begun September 1, 1895. Owing to an agreement with the railway company all the material arrived at the spot without transshipment. The engine and dynamo room, illustrated in Fig. 1, measures 230 feet long by 76 feet wire, and 52 feet high. The framework is of iron, and the roof, as well as the walls, are of wood covered with corrugated iron. A 25-ton overhead crane was erected at the very start and assisted in the erection of the machinery. The machines are all mounted on a continuous bed of concrete, resting on hard rock about 16 feet below the level of the floor.

The boiler room, illustrated in Fig. 2, is 250 feet long and 48 feet wide. It has two wings, each capable of taking in five boilers. The two iron chimneys are 16 feet in diameter at the base and 10 feet at the top. The coal storage is sufficient to hold a reserve for several months. Complete arrangements for unloading have been installed. The coal being raised to the storage pockets by an Archimedean screw, which brings the coal to the foot of the wall of the boiler house. Automatic stokers of the Leach system are employed. The ashes are raised in small wagons on a special track. The entire operation of the boilers and fuel is effected electrically by motors taking current from the large dynamos. The boiler feeding was made a special study, owing to the fact that the quantity of water available was limited. To prevent corrosion of the tubes and to obviate their frequent cleaning surface condensation was adopted, and no fresh water enters the boilers without being filtered.

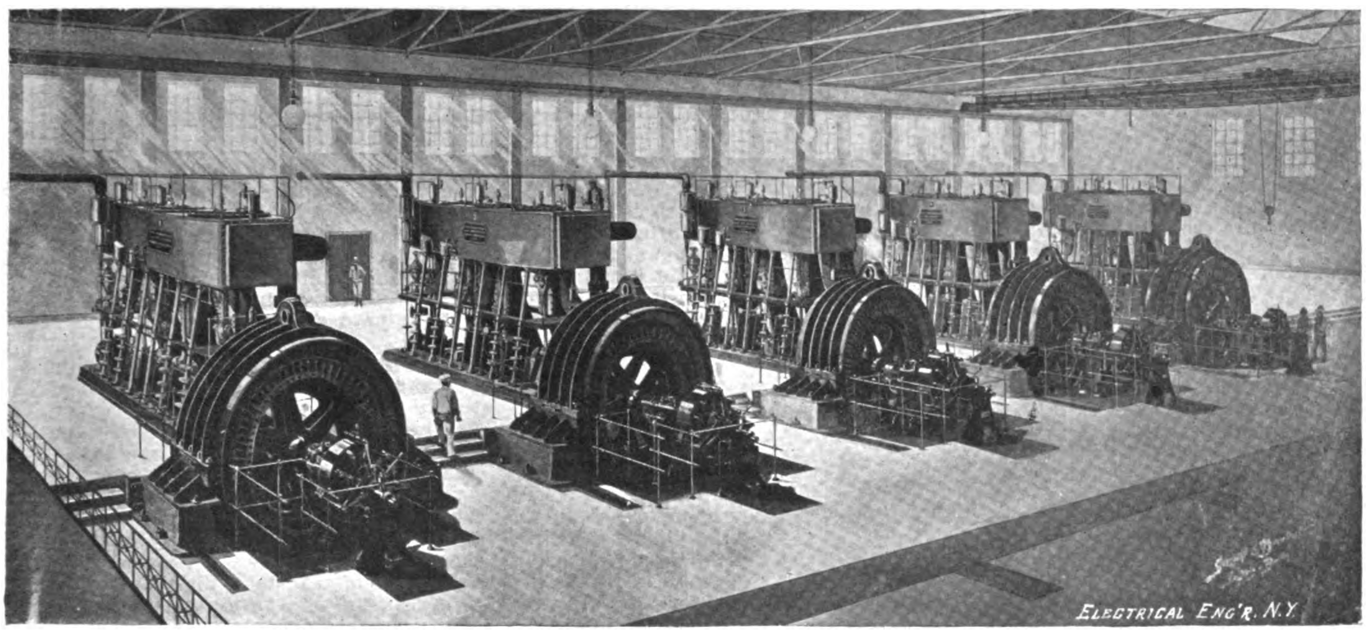


FIG. 1.—DYNAMO ROOM, RAND CENTRAL ELECTRIC WORKS, JOHANNESBURG, SOUTH AFRICA.

The engine room contains four upright triple expansion engines of 1,350 h. p. These engines, operating at 100 revolutions per minute, are direct connected to the dynamos and their exciters. Each unti has a normal capacity for 1,000 h. p.; one of them being always held in reserve gives an available 3,000 h. p. to distribute among the motors at the various mines, at which point 2,100 h. p. can be effectively counted on.

The dynamos and the entire electrical apparatus were furnished by Messrs. Siemens & Halske, of Berlin. Each machine is of 1,145 kilowatts capacity. The armatures are stationary, in the form of a ring having a diameter of 16 feet. The field magnet revolves within the armature, being keyed to the shaft driven from the engine. Each machine weighs 80 tons, and was made in four parts so as to facilitate transportation.

The dynamos generate three-phase current at 700 volts. Step-up transformers raise the potential at the station to 10,000 volts, at which pressure the current is transmitted over the line. The principal line is overhead, and consists of six copper

wires carried on steel poles 20 feet high. The longest line is over 28 miles in length.

In order to guard against lightning the Siemens & Halske lightning arrester has been successfully employed; this arrester is illustrated in Fig. 3, and was described in detail in our issue of May 12, 1897. Tests with a pressure of 20,000 volts have shown this form of arrester to act promptly and effectively.

At every point where the current is utilized, that is, close to each mine, the Rand Central Electric Works has erected a transformer house, as well as measuring instruments and safety appliances. The transformers in these little houses step down the pressure from 10,000 to 120 volts for lighting, or to 240 or 500 volts for motors. The price charged for current is lower than that for which the mines can produce it themselves. The charge is $225 per h. p. per annum, the power being measured at the electric motor shaft. For intermittent use, such as at Johannesburg, electric meters are employed, where the charge is from 3 to 3½ cents per h. p. hour.

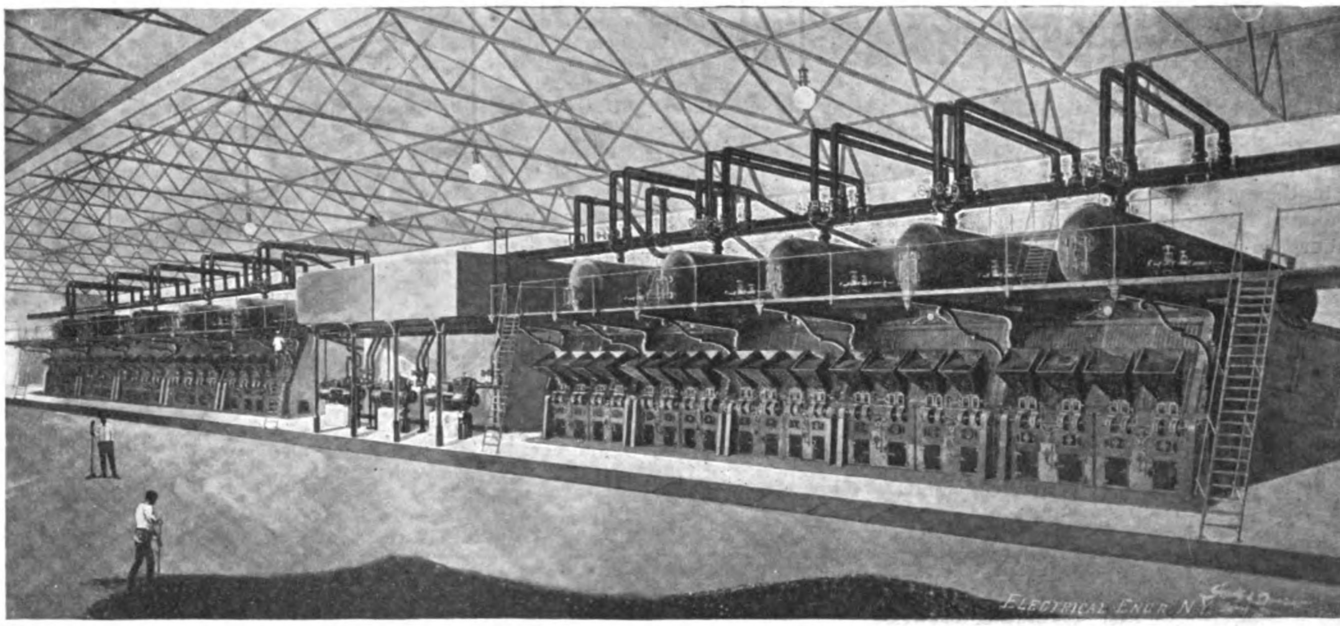


Fig. 2.—Boiler Room, Rand Central Electric Works, Johannesburg, South Africa.

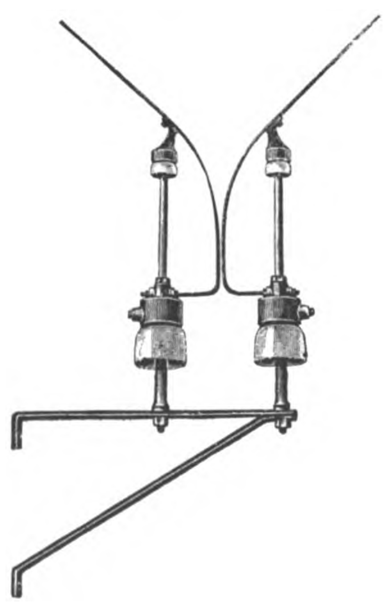


Fig. 3.—High Potential Lightning Arrester.

BROOKLYN BRIDGE.—The contract for the ironwork to be used in running the electric cars across the New York and Brooklyn Bridge has been let to the Pencoyd Bridge and Construction Co., of Philadelphia.

THE FLUSHING, L. I., ELECTRIC LIGHT AND POWER STATION.

THE small electric station, as well as the large one, has its interest for the engineer, and although the apparent magnitude of the undertaking of the one is small in comparison with that of the other, the problems involved in the small station are often more difficult of solution and are of a peculiar kind. It may in fact be safely said that the engineering ability required to design the smaller plant is of quite as high an order, as it becomes a question not of handling a variable quantity at wholesale, warranting the employment of all the little and big economies which engineering ability has devised, but of handling a more variable quantity at retail—on a scale which would render the above referred to economies in such cases extravagances, and yet produce a fairly economical mechanism.

The latter problem was the one that was presented in the city of Flushing, L. I., a small but thrifty and growing community, which had already outgrown one plant, but which, with the metropolitan bee buzzing in its ears, demanded something more modern than had done service in its village days.

The situation was not far different from that which is found in many other small communities consisting largely of residences somewhat widely scattered and small retail stores, the characteristic of the service being an extremely low load factor. To meet this service economically, to provide for a small already existing power demand, and which it was the desire to cultivate and increase in the future, and to provide direct current arc lighting for the streets and stores, were the particular conditions Mr. F. H. Thompson, the mechanical engineer of the company, and Messrs. Westinghouse, Church, Kerr & Co., the contracting engineers, who designed and installed the plant, were required to meet, and the result, as will be seen from the following description, is an exceedingly compact and flexible design.

The buildings, located on a narrow strip of land lying between the water and Lawrence street, near Bridge street, consist of two communicating structures, in one of which is located the steam generating apparatus, and in the other the engines, dynamos and offices. They were both built by the Berlin Iron Bridge Co., and consist of skeleton steel construction filled in with brick. The roofs are of corrugated iron, with monitors on each, providing ample ventilation and light, carried on steel trusses, in the engine room lined with the Berlin Iron Bridge Co.'s non-conducting, fireproof, non-condensing lining. In both the boiler and engine room, the floor is one solid body of concrete, and the whole is absolutely fireproof.

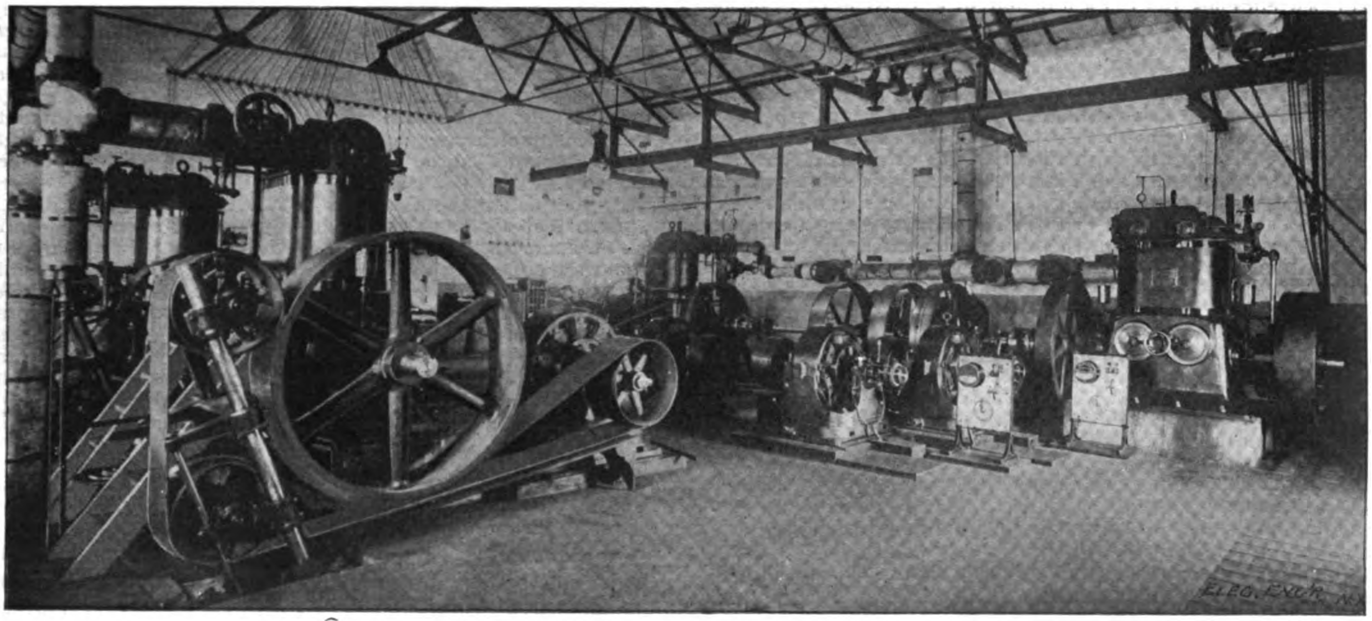
THE BOILER HOUSE.

This building, which faces on the water, occupies a ground area of 40 feet 6 inches by 40 feet, and is equipped with four 61-inch Manning high pressure boilers, each of 150 h. p. Centennial rating. These are arranged along one side of the room

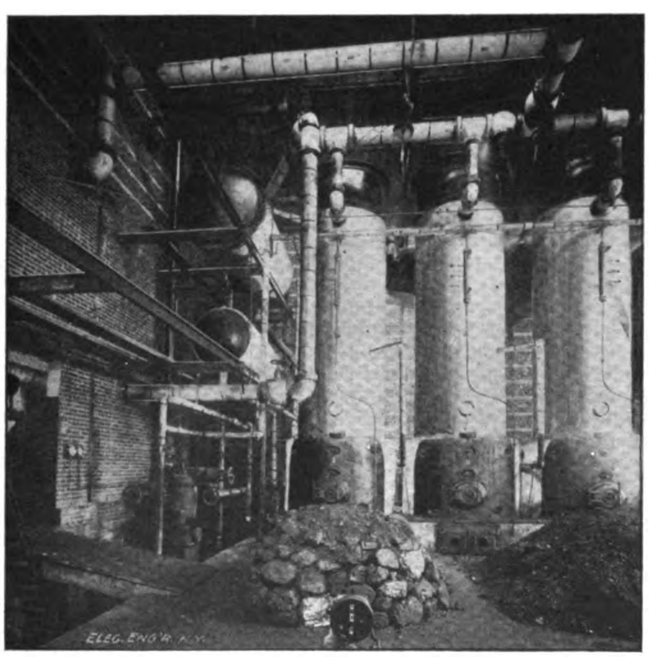
and adjoining them next to the dynamo room are located the boiler feed pumps, which are the Dean duplex, 6x4x6 inch.

Beneath the building the company has sunk an artesian well from which the boiler supply is taken by a low service steam pump, and discharged either into a large tank just outside or directly into the exhaust steam heater. Arrangements are made, however, so that the pumps can draw either from the exhaust heater, the tank, the well, or the city water mains.

Directly over the condensers, and therefore occupying no otherwise useful space, are located the live steam purifier and exhaust steam heater. The Hoppes system of feed water purifying is used, rendered necessary by the quality of the water, which is not the best, the water being usually pumped from the well by the low service system into the exhaust heater, and thence by the boiler feed pumps into the live steam purifier, whence it descends by gravity into the boilers, the elevation of the purifier being sufficient for this purpose.



WESTINGHOUSE ENGINES AND DYNAMOS, WITH L. P. & D. TRANSMITTERS, FLUSHING, L. I., ELECTRIC LIGHT AND POWER STATION.



BOILER ROOM, FLUSHING STATION.

The steam for operating all of the auxiliaries is ordinarily taken from the live steam purifier instead of from the boilers direct so as to provide circulation in the purifier, but provision is made, by means of a supplementary heater connected with each boiler, to permit direct connection in case the purifier is for any reason out of service. The exhaust from all the auxiliaries is discharged into the heater.

The condensers, which are also located in this corner of the building, are of the Dean independent type in pairs, and are arranged with by-passes so that either condenser can be run with any combination of engines. The exhaust pipes are provided with automatic relief valves, and the condensers are supplied with salt water through cast iron suction pipes.

The above equipment occupies one side of the boiler house, the foundations for an exact duplicate being provided on the other side. Thus it will be seen that within an area of 1,620 square feet of floor space there is provided generating capacity for 1,040 h. p., Centennial rating, or about 1 h. p. to each 1.5 square feet, including all auxiliaries, pumps, condensers, steam heaters, purifiers and coal room.

Just without the boiler room is located the stack, which is worthy of notice. This is a steel cylinder, 54 inches in diameter and 125 feet high, weighing 24,000 pounds, and was erected in one piece. Its foundation consists of a solid block of concrete 15 feet square and 10 feet deep, laid on piles. On account of the narrowness of the property, which is bounded on the one side by the street and on the other by the water, it was impossible to support this tall shaft by guy wires, so it was necessary to design it to be self-supporting.

ENGINE AND DYNAMO ROOM.

This building, exclusive of the offices, which are partitioned off at one end of the room, is connected with the boiler house by a single door, measuring 41x48 feet inside. It contains, besides overhead cranes running the entire length of the room, four Westinghouse compound automatic engines, with cylinders measuring 12 inches by 20 inches by 12 inches, and indicating 150 h. p. when operating condensing at 125 pounds of steam.

Two of these are located on the east side of the room, each driving a 75 k. w. two-phase Westinghouse alternator and a small direct current exciter, and there is a foundation for another unit of the same size. These are for the incandescent lighting and power service, and on the other side of the room are located the other two engines of the same size, devoted to direct current arc lighting service. This is supplied by three Westinghouse 75 light and one 100 light direct current open coil arc machines. There is also a reserve incandescent dynamo of 75 k. w. capacity on this side.

The method of driving these machines is one which, while not entirely new, is not yet very common, viz., the L. P. & D. transmitter manufactured by the L. P. & D. Transmitter Co., of Montpelier, Vt. This is well illustrated in one of the accompanying engravings. One of the advantages which commended this device to the engineers was that it permitted of very close belt centers—two of the arc machines being belted on 4 feet 3 inch centers, and both of the incandescent machines on 6 feet 6 inch centers, which is certainly about as compact an arrangement as is possible where, on account of the smallness of the units, it is advisable to use belt transmission.

Another illustration of its utility is shown in this station on the arc light side of the building. As before stated, this side of the room contains two 150 h. p. engines from which are driven four arc light machines, but it was the design to hold one of these machines and one of these engines as a reserve. To accomplish this, and to add flexibility to the system, these engines are connected with either end of a jack shaft by means of jaw clutches and the arc machines are driven from separate pulleys on this jack shaft by the L. P. & D. transmitters. The incandescent reserve unit is driven from the spare arc engine unit. With this arrangement either engine may be thrown into connection with the shaft and any one, or all of the arc light machines or the reserve incandescent machine, may be thrown either in or out of service, without the aid of clutches by simply changing the adjustment of the transmitter belt.

All of the engines are operated condensing, a single valve and a single eccentric controlling the steam of both cylinders. This is a great simplification over the usual valve gear of compound engines, and permits of their being operated non-condensing or condensing without any changes in the valves or their setting.

As regards lubrication, this is both copious and economical, being effected in the well known manner peculiar to this make of engine, by the churning action of the crank shaft and connecting rods running at high speed in a closed reservoir of oil and water, the splash deluging every friction surface. The governor is also enclosed in a case which is filled with oil so that the lubrication is both generous and automatic and all wastes are prevented.

The incandescent lighting machines are of the well known Westinghouse two-phase type, the armature being drum wound with connections taken out at four points 90 degs. apart. The current is distributed at 2,000 volts, with 7,200 alternations supplying lights on the single alternating system and power on the two-phase system.

THE ARC DYNAMOS.

Returning now to the other side of the station the arc light machines are worthy of a passing word. These are of the constant current open coil type, but while really wound as two-phase machines, are commutated so as to give a unidirectional current. Instead of being self-excited, as is usual with direct current arc machines, these are separately excited from a small exciter, which also does service when necessary in supplying the station lighting. This commutated two-phase current is slightly pulsating, but this is claimed as an advantage, as it causes a very slight but constant vibration in the moving mechanism of the arc lamps, which materially reduces the chances of sticking or failure to feed, without perceptibly affecting the steadiness of the light.

The armature coils of these machines are entirely enclosed in the metal of the armature so that it is effectually protected from possible mechanical injury. The stampings of which th core is built up have eight T-shaped teeth upon which the armature coils previously wound on forms are mounted and held in place by wooden wedges dovetailed in. By the arrangement employed the replacing of a damaged coil is an exceedingly simple matter and can be performed by an ordinary mechanic in a very short time.

A word also about the commutator and method of commutation may not be out of place at this time. As is usual with all open coil constant current machines relying upon their high self-induction to prevent disastrous cutting by sparking, the dead spaces between the commutator blocks are wide. In the earlier types of this machine these spaces were either left vacant or were filled in with some solid insulating material. In the former case the brushes were apt to chatter and in both cases they behaved badly with the tool when it was necessary to put them on the lathe to turn them down. A very simple and effective remedy for both troubles was found by introducing into this air gap an intermediate narrow block of copper, insulated of course both from the shaft and from the adjacent commutator segments. This arrangement has proved very effective.

There are in this machine eight armature poles, but only six field poles, but by the method of commutation two of the armature coils are always dead.

But the most interesting feature of this machine is its method of regulation. While Sayre in England and Ryan in this country have been trying to overcome or nullify armature reaction the designers of this apparatus have taken the bull by the horns and converted it into a useful agent. By a bold step they have striven to magnify this armature reaction to the highest extent and thereby have obtained a characteristic beyond the bend which is essentially a vertical straight line, which means exact regulation within wide limits solely by means of armature reaction. Then in addition to this by means of the unvarying field excitation they have extended this regulation so that if the dynamo be absolutely short circuited the rise of current will not exceed 1-10 ampere.

The switchboard needs no special mention except that it is a handsome marble structure equipped with plunger switches for the alternating current and operates the generators in multiple except during light loads.

All of the steam piping in the establishment is extra heavy and provided with valves and fittings so as to be interchangeable, enabling any boiler to be put on any engine. The pipes, boilers, heater and purifier are covered with crimp asbestos paper furnished by the New York Air Cell Co., and thus are well protected against radiation losses.

In closing, it is worth while calling attention again to the very compact arrangement of this plant, which for a belted one with units of the size employed probably has never been excelled.

In the boiler room it was found that there was but 1.5 square feet for each rated horse power of steam generating plant, including all auxiliaries except stack. In the dynamo room the following figures obtain: Each 75-light arc machine occupies 4x5 feet 6 inch floor space. Each 75 k. w. unit, including the 150 h. p. engine, dynamo and transmission, covers a floor space of 10 feet 6 inches x 8 feet 6 inches, or 91.3 square feet = 1.2 square feet per k. w., and the dynamo room as a whole including engines, dynamos, transmission, switchboard and all accessories, as well as ample clearance space, is on a basis of but 2.6 square feet, per indicated horse power.

UNDERGROUND CIRCUITS FOR ARC LIGHTING.

By S. H. SHARPSTEEN.

THERE is no question that the arc light is the best for illuminating parks and the grounds about public buildings. One serious drawback with such lighting is the stringing of wires overground. It seems to the writer that this should not be, since the circuits can be placed under the ground now without an exorbitant expense. The following is deducted from experience that the writer has had with such work.

Almost all arc lamps working from regular arc machines use 10 amperes of current, hence the lead covered cable does not require a conductor larger than the No. 6 B. & S. gauge, stranded. The rubber should be about ⅛-inch and the lead 3-32 of an inch thick. It is a good plan to have the cable drawn in a duct so that it can be drawn out for repairs, but such is not necessary, as a good permanent job can be done by laying the cable in a trough and covering the trough with strips of wood, and filling in the ditch with dirt. The writer would not recommend a combination of overhead and underground work to be used together, as the lightning is apt to puncture the insulation of the cable.

As a person can readily understand, the lead on the cable extending underground so far makes an excellent ground plate, and the temptation for the lightning to pass from the overhead line to the ground through the cable is strong. Lightning arresters can be used, but they may protect the cable and they may not. The writer once made adverse comment on making such a combination and an electrician who was standing near by said: "There are lightning arresters on each end of the line on the switchboard, hence the lightning cannot hurt the cable." It is this kind of an expert that sometimes selects the lightning arresters and installs them, hence it is not hard to guess at what the results might be. If the two are combined the cable should be run in a duct so that it can be pulled out for patching when punctured. It may occur to some that the cable runs up to the lamp in the pole and can receive a difference of potential from atmospheric disturbance just the same as though it passed up a line pole and attached to line running through the air. The writer won't claim but that the proper people could make the combination of the two systems of wiring by running the lead cable up the line pole, lead and all, and putting there the proper lightning arresters to protect the insulation of the cable. But how long will the lightning arrester stay before being burned out and changed, and before it will be tampered with by some amateur and so fixed that it will not arrest?

In the case of the loop running up to the lamp on top of the pole we might say that the pole should be of iron, and in contact with the lead on the cable both at the top and bottom.

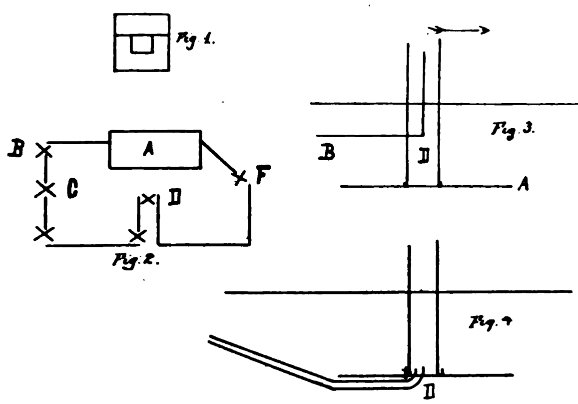
If there is a big difference of potential between the air at the lamp and the ground at the foot of the pole or some place on the line of the cable, the current would pass into the iron lamp pole and the lead on the cable because the surface exposed would be large and would be higher than the point to which the conductor in the cable goes. In all cases the lead on the cable should pass up through the pole and be cut away

about two inches back from the point where the conductor enters the lamp.

The hood on top of the pole and over the lamp should be connected with the pieces of pipe that hold it up and the pipe, in turn, connected firmly to the iron cross piece on top of the pole.

If the hood was not connected to the iron work, but fastened to the wooden board to which the lamp is to be fastened and in turn the wooden board fastened to the pieces of pipe, which is often done, then there might be an enormous difference of potential between the hood and the ground; the result might be that atmospheric current would pass into the horn of the lamp, from there into the conductor fastened into the lamp and from the conductor through the insulation in the cable to the lead covering, thus making a puncture.

None but the most skilled, careful and trusted men should



FIGS. 1, 2, 3 AND 4.

do this kind of work. A sharp bend over a corner of iron, jamming into the wooden trough upon a pebble, kinking, flattening by letting it lie on hard ground and a team driving over it, driving a nail through the lead when the carpenter is fitting on the cap around some bad place; all these things are liable to happen if the utmost care is not taken and any one would be liable to break down the insulation of the cable. Where the cable is not drawn into ducts as it is unreeled, it has got to run out on the ground before being laid in a trough, thus exposing it.

The trough in which the cable is to be drawn can be made out of white pine, and should be about four inches square, cut as in Fig. 1, having a cap and a small groove in which to lay the cable. The trough and cap possibly would last better if well painted with some good preservative paint. The writer has used P. & B. compound. Creosoted trough could be secured from the people that make wood ducts for underground telephone work. If very much was to be used this, no doubt would be the proper thing to do, but for only a few hundred feet there would be no economy.

The object of this wooden casing is to surround the cable with something firm enough to prevent it from getting jammed from stones, tools, etc. If not thus encased the cable might at some time be punctured by a pick while a laborer was digging in the ground for some other purpose. Better results are apt to be had if the cable is ordered in long lengths so that it can be cut to run from the binding post of one lamp to the binding post of the next without a splice. It is a tedious job to make a proper splice in an underground cable, and if there is any trouble it is apt to be laid to the joint. By making very careful measurements possibly the cable can be ordered in lengths suitable to pass from lamp to lamp. This would only be necessary when the lamps were a very long distance apart. Some allowance has got to be made for bends that will get into a cable in spite of all that can be done. In drawing into a duct they can be pulled out, but when the cable is laid into a trough it cannot very easily be made perfectly straight.

There is one excellent thing about the series system of installing arc lamps and that is, only one sized wire is necessary and the wire can be run singly and do the work. For instance, the cable could start from one side of the station, as in Fig. 2, and pass underground to the lamp B, then to E, and so on around, coming back to the station from the lamp F. The circuit of a number of lamps could be made with only one trough and cable in a ditch, save when some out of the way point was run to, as D, when two pieces of cable would have to lie side by side in the same ditch.

One would naturally think that the conduit would be of the most importance, but such is not the case. After once the cable, with a good lead cover, is down, and the ground is settled and the cable is sound it will stay, if there is not something in the soil to destroy the lead.

Such is not the case with the cables about the poles. There is a constant swaying to the poles when the wind blows and this swaying will cut a hole in the cable if the pole is not properly set and the cable protected. The writer once laid an arc light cable, the specifications calling for it to be two feet under the ground, and the poles to be set five feet in the ground. The result was that holes had to be made in the poles for the cables to pass in and out. The foot of the pole, according to specifications, was set in a recess in a cast iron plate. No cement was called for around the pole. By looking at Fig. 3 it can be seen what was the result. A, was the cast iron plate; B, the cable passing up the pole, and G, the surface of the ground. When the wind would blow in the direction of the arrow, the stiff pole with a large hood on top would go along to some extent. At A the pole was unmovable; consequently, at D, where the cable entered the pole, the latter would move back and forth.

This was a mistake; the cable should have run along at the distance of two feet under the ground until it came near the pole, say ten feet away, and then it should have dipped down and gone under the cast iron plate and up through the center of the pole, as illustrated in Fig. 4. With this arrangement, if the pole is grouted in a proper manner, it is almost impossible to have the cable damaged. The plate under the pole should be at least two feet square and should stand on firm ground so that the pole cannot work down and damage the cable. The pole ought to be at least six inches inside diameter at this point and then at D, Fig. 4, there should be an angle piece made in halves of brass, round inside, and shaped to fit the angle in the cable and this angle piece should be screwed onto the cable and placed up against the casting. This precaution will prevent some careless fellow from pulling up on the cable from the top of the pole and damaging the cable where it makes the bend.

Now points enough have been considered so that placing the cable can be commenced. The pole is set up on the cast iron base, in the hole where it is to stand, and well guyed fast. Next, the cable is passed under the plate up the pole, and fastened into the binding post in the lamp or left long enough to be sure and reach that binding post when the lamp is hung.

If there is any danger of the cables having any hard usage on top of the pole by lamp trimmers, etc., it is a good practice to take some hose and pass it over the cable far enough down to extend past the pole cap E, Fig. 5.

Commencing at D, the cable should be bound securely to the pipe F, full length. The pole cap E should not be made as usual, but should have a recess sloping down, from the

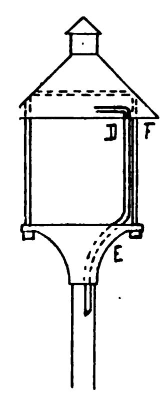


FIG. 5.

point where the pipe meets the cap, to the hole where the pole comes up into the pole cap. This will allow the cable to lie down out of the way and save it from so decided a bend that it would have if the recess was not in the cap.

The cable will now be lying in the trough, said trough extending under the plate up to the point where the brass angle piece is to be fastened, see Fig. 4. It will be necessary to fasten a lever to the pole and lift it directly up far enough to let the wiremen put the screw into the brass angle pieces. Care should be taken in lifting the pole that the cable is pushed forward as the pole goes up and not have any damage done on the edge of the plate. If it is desired to have the poles stand perfectly straight through the whole year without any attention it is quite essential to grout them in.

If the ground is well tamped the poles will stand fairly well, but they should be straightened up in the early summer after the ground has settled, especially if they are in a windy

place. The great drawback with using cement and stones is the fact that cable and pole become a solid mass and it makes it impossible almost to get the cable out of tne pole for any purpose that might require it. In running down a side hill it might be a good precaution to see that the trough with the cable in does not end in an open place so that the trough might become a waterway.

Muddy water under pressure might run around the cable and cut the lead. The writer's attention was calleu one morning to a piece of unfinished work, where the water was coming out of the wooden trough at a lively rate. When looking over grounds for such work sometimes a long building will come in the course of the circuit. In such a case it is an easy matter to let the lead cable extend into the building; then splice on a solid rubber-covered wire, pass up to the floor joists, and continue on under the floor to the farther end of the building.

Extra precautions should be taken where the lead cable ends to prevent moisture from getting back into the cable. With resin solder and a soldering iron the stranded end of the cable should be made solid, then the end of this cable should be fastened to the solid wire by a coupling, the whole well soaked with a good grade of hot compound, taped over, filled again with compound, and well taped again.

The end of the lead cable should extend up the side of the wall for some distance, to keep water from following up the cable to the joint. The object of the coupling in place of a solid joint is to enable the cable to be disconnected from the wire for testing purposes. When giving the thickness of rubber for the insulation in the cable it was considered that not more than 25 lamps would be wired upon it, limiting the pressure to about 1,000 volts.

ELECTRIC TRANSPORTATION

THE DISPLACEMENT OF THE CABLE BY THE UNDERGROUND TROLLEY IN WASHINGTON.

By N. M. HOPKINS.

With the application of electricity to cable conduits, another promising branch of electrical engineering has been developed, the future life of which is only limited by the existing number of mechanical roads with their certain electrical futures. Perhaps in no other instance has the displacement of a mechanical system by electricity been more marked than in the evacuation from subways of the moving cable and revolving pulleys, in favor of stationary electrical conductors, and fixed insulators. The topographical or parallel resemblance of the two systems, with their supported horizontal

Fig. 1.—View of Metropolitan Railway Co.'s Power House in Flames, Washington, D. C.

masses of metal, in motion and at rest, respectively, appears to the writer to illustrate very forcibly an instance of electrical progress having overtaken mechanical methods, and driving them from their own ground. It almost appears to-day as if the expensive cable conduits were designed with the intention of meeting the requirements of the underground trolley, when the mechanical system had run its race.

With almost every cableway, however, specific problems have arisen as to the best and quickest manner of making the change, after the decision to introduce electricity. The forms

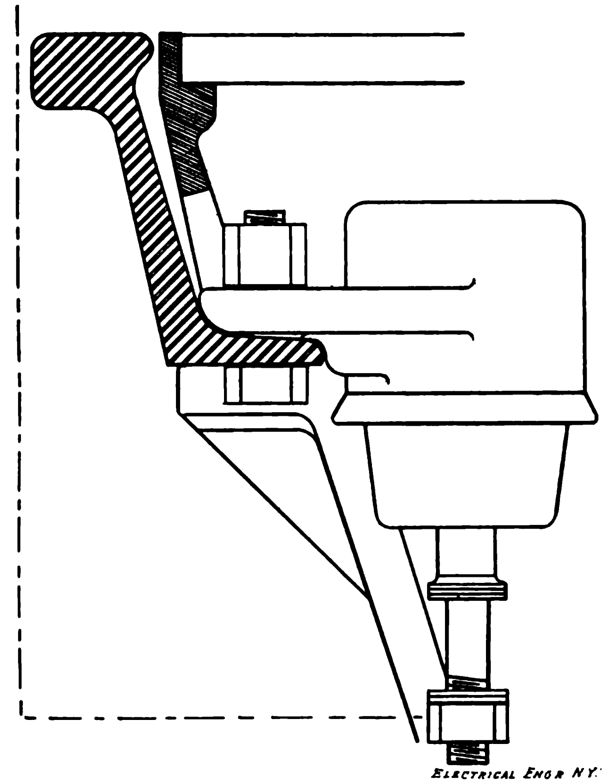
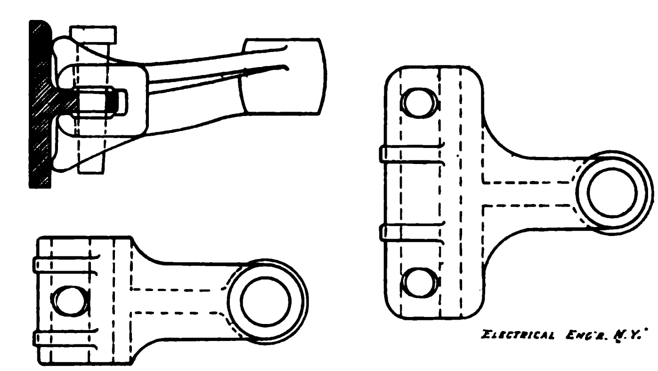


Fig. 2.—Method of Attaching Insulator to Old Slot Rail in Cable Conduit.

of yokes and the methods of attaching the slot ways, and distribution of man and hand holes, differ throughout the country where cable roads exist, owing to the antiquity of the system, and the various forms of yoke castings, track and slot designs which have developed in different cities, meeting very varied requirements.

Chief among hurried changes of system, with which time constitutes an element of great importance, financially as well as regards public convenience, is the transformation from cable to electricity, of the extensive Navy Yard and Georgetown division, with the Fourteenth street branch, operated by the Capital Traction Co., of Washington, D. C. As the result of

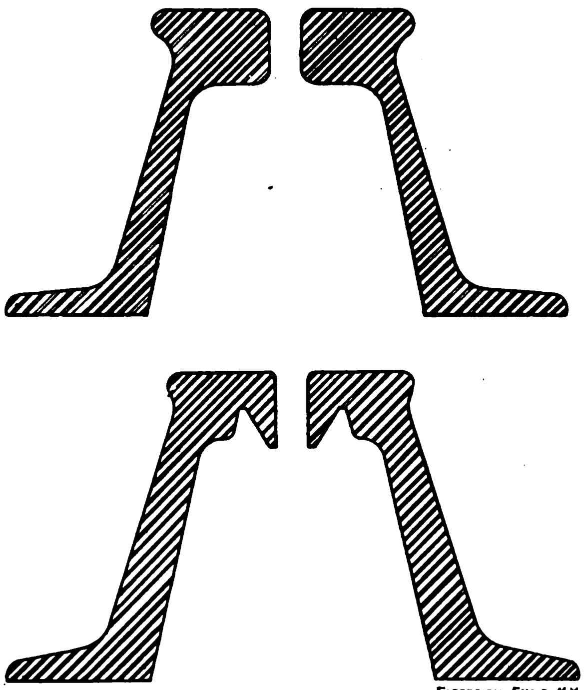


Figs 3, 4 and 5.—Method of Attaching Insulator to Old Slot Rail in Cable Conduit—Iron T Conducting Rail and Malleable Iron Supporting Clip—Intermediate or Simple Supporting Clip.

one of the fiercest fires ever fought in the District of Columbia the former superb cable machinery, and the spacious six-story building, known as the Central Power Station, now presents a mass of hopeless ruins. An idea of the severity of the conflagration may be gathered from the furnace-like view of the burning building, Fig. 1, the reproduction of a night photograph, taken from the North side.

The Capital Traction Co. was the pioneer rapid transit com-

pany in Washington, and its former energy then so thoroughly appreciated, is now again prominent in pushing the work on its new system, with every promise of giving its lines an equipment second to no road of the kind in the world. The former mechanical power station was approximately in the center of the road system, and although electrical requirements, as well as mechanical, favor such location, the new plant is to be at the Georgetown end of the line because of exceptional coal and water facilities. The building for the new station was formerly in use for manufacturing purposes, and is



Figs. 6 and 7.—Section of Old Cable Slot Rail and New Drip Slot Rail.

situated on the incline of a hill with a canal for water supply at the top, and the Potomac river, as a means of coal conveyance at the foot. This location, with its surroundings, has been pronounced to be one of the most promising situations for an economical steam generating station.

With the destruction of the cable machinery seven and a half miles of double track were crippled until horses could be bought, and a horse railroad temporarily established, using the trail cars. Among the schemes to quickly re-establish rapid transit was a proposition from the Walker Electric Co. to revolve the cable drums by electric motors, with power leased from the United States Electric Co., which is within a stone's throw from the destroyed steam plant and cable equipment. The drums, as well as the other cable paraphernalia, were cracked, warped and hopelessly distorted, so all consideration in that direction was at once abandoned. Having decided upon the immediate installment of the underground trolley, orders for new cars were issued without delay and electrical men called in to consultation, with the mechanical men connected with the road, to draw up the working plans.

The method of attaching the conducting rails to the conduits was of course among the early problems, and Fig. 2 conveys a clear idea of the scheme for attaching the insulator to the slot rail, instead of working on the yoke. With this plan it is only necessary to drill two holes through the rail for each insulator, so the work of hanging the conductor will progress quite rapidly when the material is assembled. The conductor is "T" shaped and is similar to the rail used on the recently installed sub trolley of the Metropolitan Road, also of Washington. Fig. 3 illustrates the type of hanger designed to meet the requirements, which has been approved by the engineers for the company. The rails, or conductors, will be most thoroughly bonded with standard copper in double drillings. Figs. 4 and 5 illustrate intermediate, and bond clips, respectively. It is likely that some arrangement will be made for temporary power from one of the electric companies, for the earlier operation of the Fourteenth street branch.

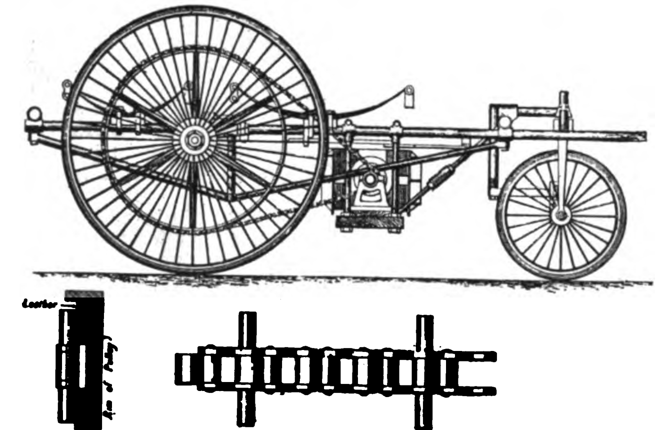
Seventy new cars have been ordered from the American Car Co., of St. Louis, and will be equipped with G. E. 1,000 motors. The cars will have mahogany fittings and have eighteen foot bodies, and will be run at a considerably increased speed over the old cable. Fourteen feeder cables will leave the power station, representing 1,000,000 circular mills of copper.

Fig. 6 shows the present cross sectional form of the slot rails, and Fig. 7 the cross section of the recently installed slot rails of the Metropolitan Company. The road will be tried with the old smooth rails first, and should it become necessary to equip the line with the "drip" rails, a special device will be experimented with to accomplish the dripping effect. It has been suggested that a special cutting tool might be worked without disturbing the rails or track, but this experimentation has been deferred for the present.

All of the contracts for material have not as yet been let, but enough can be gathered from the following description of the generating station to stamp the same as first-class equipment. For the present only sufficient machinery for the actual requirements of the road will be installed. Three Cahall Babcock & Wilcox water tube boilers of 600 h. p. each will supply steam at 130 pounds initial pressure. Coal will be brought by way of the Potomac river, and fed to the furnaces by Roney mechanical stokers. Water will be taken from the canal, passed through a gravity filtering plant and supplied to the boilers. The pump contract has not as yet been let. Three Allis tandem compound engines of 750 h. p. each, with cylinders 20x40x42, 100 revolutions per minute, will be directly connected to three General Electric multipolar railway generators. The capacity of the machines is 525 kilowatts, with a voltage of 550 at no load, and 600 at full load. Boosters will be used of General Electric manufacture. The former cable plant was modern in every respect, with rope driven drums, duplicate engines and powerful battery of water tube boilers. The building was much larger than the requirements of the cable equipment demanded, and was popular for small manufacturers and printers who leased power with the rooms on each floor, above the ones reserved for the machinery, and the business offices of the company. The company has Mr. D. S. Carll for superintendent and chief engineer; Mr. J. H. Hanna, assistant superintendent; Mr. W. B. Upton, principal assistant engineer; Dr. Louis Duncan, consulting engineer, and E. Saxton, contractor.

THE ELIESON ELECTRIC DOG CART.

One of these cars having now been running for some months past, a few details will doubtless be of interest. For the general design of the car we refer our readers to the



Figs. 1 and 2.—Elieson Electric Carriage, Showing Details of Driving Gear.

accompanying illustrations, taken from the London "Electrical Engineer." The frame (Figs. 1 and 2) is composed of Mannes-

mann steel tubes. Thus not only are great strength and rigidity obtained, but also lightness is secured. These frames are built by Mr. John Warrick, of Reading, maker of the "Monarch" delivery cycle. The motor is suspended underneath the cart from the tubular frame, and two chain gears are used to transmit the motion of the motor to the driving wheels of the cart. This chain gears with the teeth of a sprocket wheel on the motor spindle, but one of the rivets in every third link of the chain is lengthened and stands out about an inch on either side of the chain. Round the periphery of the driving pulleys (fixed one on each hind wheel of the cart) two bands of leather are fastened. These bands are spaced the width of the chain apart, so that the chain runs between these two bands, while the extended pins grip on the leather. A most absolute grip is obtained by the pins on the leather. The makers claim that this gearing secures what no other gearing has ever before obtained—that is, the combination of a positive driving with the advantage hitherto peculiar to belt driving alone—namely, that in turning corners it permits slip to take place on one side, for when turning a corner, while one wheel is

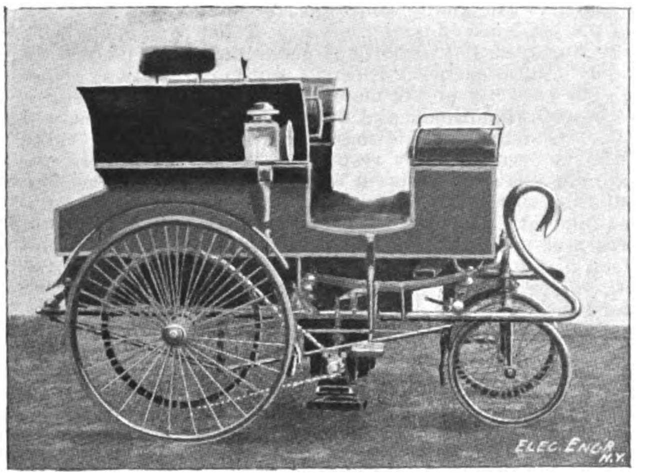


FIG. 1.—ELIESON ELECTRIC DOG CART.

checked, the other revolves at its normal speed, and the chain slips on the former, but as soon as it is required revolves it by friction like the other. It may be thought that a slip will take place when not required, such as when ascending steep hills. This matter has been fully tested by ascending Haverstock-hill at a very good speed. The steepest gradient in this hill is 1 in 15, others being 1 in 18, 1 in 25, 1 in 29, 1 in 34, length 3,750 feet.

The special type of cart illustrated in Fig. 3 is intended for city use. Take, for instance, a man living five or ten miles out of the city. He drives into the city in the morning, and whilst engaged in business his cart, is being charged. This charge is sufficient to carry him home and into the city again the next day.

Energy is supplied to the motor from a battery of Lamina accumulators. The plate of a "Lamina" cell is of the Planté type, and is composed of sheets of perforated and corrugated lead. The sheets are so arranged that the corrugation runs alternately vertically and horizontally. Thus great surface is obtained, and also a good circulation of the acid. The plates are contained in ebonite boxes. The following are the weights and efficiencies guaranteed by the makers for one of the traction cells containing seven plates and weighing complete 27 pounds: Charge rate, 15 to 25 amperes; discharge rate, 20 amperes. The capacity at 20 amperes discharge is 100 ampere hours, or a capacity of 120 ampere hours if discharged at 10 amperes.

BOSTON WEST END LEASE NOT RATIFIED.

In a special report issued last week the Massachusetts Railroad Commissioners refused their approval to the lease of the West End Street Railway Company by the Boston (Elevated) Railroad Company. Without this approval the lease cannot become valid. Two principal reasons are given for their refusal. The first of these is that the lease as drawn takes the West End out of the special class of railways that may be controlled at any time by specific legislation and places it under the charter of the Boston Elevated Railroad Company, which especially provides that "no other burden, duty or obligation which is not at the same time imposed by general laws on all street railway companies" shall be placed upon it. This in the opinion of the commissioners, removes an important safeguard to public security and convenience in the conduct of the road, by making it necessary to apply to every road in the State any measure needed to correct local abuses of any kind.

The second important defect with the lease as it affects public interests is that from the long term, ninety-nine years, it would exercise an important influence toward blocking any reforms in the reduction of existing fares, because of the large compensation to be paid to the West End, which would, in the opinion of the commissioners, tax the earning power of the new company to the utmost. The Elevated Company agrees to pay 8 per cent. on the stock of the West End, besides other charges and expenses that would bring the total up to 11 per cent. on the par value of the common stock, which is absolutely guaranteed whether earned or not. In connection with this the report says: "The proposed lease in its present form is wholly discordant with the public policy, deliberately settled and wisely restricted by the Legislature. It is practically destructive to that policy." As this large rental must be deducted from the net earnings of the Elevated Company, before there could be any possibility of any reduction of fares, it becomes evident that this provision works directly against any such reduction.

WHAT THE TROLLEY COMPANIES HAVE DONE FOR NEW ENGLAND TOWNS.

NOTE has already been made in The Electrical Engineer of the hearings in Boston before the special committee on the relations between street railways and the municipal corporations. Some very interesting testimony has been brought out by different witnesses.

Willard B. Ferguson, of Malden, who has promoted and operated many Massachusetts street railways, gave his experience in building the Worcester, Leicester & Spencer electric railway. He said hearings were given in each town, and about one-half the stock was taken in those places. The only opposition was from Hon. John E. Russell, of Leicester, who wrote from Europe. Before that time there was no conveyance to Leicester except a coach, which made two trips a day. Now Leicester has gained $90,000 in taxable property from the road and the cars run fifty trips a day, the fare being 10 cents. To Spencer the fare from Worcester by steam train was 50 cents; by electric road it is 20 cents. In building the road all grading and widening was done by the road. Neither town paid out a cent in street improvement because of the road.

This was also true, Mr. Ferguson said, of the line between Haverhill and Amesbury, through Merrimac. The whole width of the street was graded to 8 per cent. by the road. The fare from Haverhill to Merrimac by steam train was 38 cents, the route being through two New Hampshire towns. By electric line it is 10 cents. There are three or four trips by train and from thirty to forty trips by electrics. The fare from Haverhill to Amesbury by steam train is 65 cents, by electrics 25 cents. The South Framingham, Holliston & Milford line was next described. There one of the towns paid $2,000 for street widening, while the road paid $8,000 or $9,000. Before this line was started it was impossible for a person leaving Boston after 5 o'clock at night to reach Milford or Hopedale the same night unless the traveler hired a carriage in South Framingham. Now he can leave Boston at 9 and on Saturdays at 11 and get home the same night.

The operations of the Gloucester & Rockport road, where quite a sum was paid for street improvements, were also described. He did not think the roads he operated had cost the towns a dollar, while the average reduction in fares had been 50 per cent. everywhere. Most of his roads ran at the side of the highway; where they ran in the middle of the street the company paved or planked it. The average cost of the roads was from $15,000 to $20,000. The Worcester, Leicester & Spencer road paid 4½ per cent., the Haverhill & Amesbury 4 per cent., the Milford 5 per cent. and the Gloucester 6 per cent. Mr. Ferguson said that the stock of the Gloucester & Rockport road was owned in Malden and Chelsea. Not a dollar of the stock of the Lynn & Boston road is owned in Salem, and but little in Lynn. He had no interest in either the Lynn & Boston or West End, which operates in Malden, but that city collects taxes from him on all his stock in roads in other places. He thought it would reduce the friction between the companies and towns if the corporation tax was divided back to the towns in proportion to trackage.

John M. Ackerman, general manager of the Worcester Consolidated Road, said that his company had paid out $100,000 in paving expenses in Worcester, which were not covered by

the statutory provision that the company should pave between the tracks. Other burdensome conditions had been imposed; among them the removal of snow and ice from the entire width of streets where the tracks run. At one time they were asked to pave with concrete a forty-foot street running by an apple orchard.

Harold Parker, of Lancaster, an engineer, said he thought that at times selectmen had been unreasonable in their demands. The law should more clearly define the rights of selectmen.

P. F. Sullivan, general monager of the Lowell & Suburban Road, said in nine years' experience at hearings, the first time he had ever heard the statement that there was a principle involved in this question was in these hearings. He argued that the localities had received more from street railways than anyone. A great deal was said about foreign roads. It is not recognized that the element of depreciation comes in here in a different sense. If the Lowell & Suburban had only 20 miles of track, as ten years ago, it would have less cost, less risk and better earnings than now. The receipts were then 34 cents per car mile; now they are 21 cents. He gave many figures to show that the return for the capital invested is much less than ten years ago, and all because, he argued, the company had divided its profits with the public in the way of extensions of service. If the conditions in Boston were the same as in Baltimore, the West End could afford to pay $1,000,000 for its franchise without affecting its earning capacity and dividends. The climate is entirely different, with few snow and ice expenses. The West End pays 22½ cents an hour to its men; the Baltimore company pays 15 cents. So with coal and other expenses. The little cities in Massachusetts are giving cheaper fares and better service under different conditions than in foreign cities.

In Toronto, Mr. Sullivan said, there was practically a municipal railway. The suburban roads brought their cars to the city line. There the local company operating on the city's tracks took them, with a change of conductor and motorman, and an additional fare. In Boston there are free transfers all over the lines. Under conditions such as those in Toronto, the West End would double its earnings. In the outside roads, Mr. Sullivan said, charging 5 per cent. for depreciation of plant would be about right, and it would practically eat up the dividends. It would be absurd, however, to charge only 5 per cent. for depreciation in the West End. It should be nearer 25 per cent. Mr. Sullivan spent some time in discussing the anti-stock watering laws. In two years, examinations showed, he said, an impairment of the capital of the Lowell & Suburban to the amount of $230,000, although there was no change in its plant, it being owing to the decreased price of rails and other material. The railroad commissioners had recognized this condition of things. The time is coming when the roads must charge off for depreciation, and then Mr. Sullivan wanted to be out of the business. To do it to-day would give the stockholders nothing, because of what is being given to the public. Mr. Sullivan favored indefinite franchise as to-day, subject to revocation, with the right of appeal. A term of years should cover the life of the bonds.

The last speaker of the day was Mr. Willis, of the Fitchburg & Leominster, who told about the negotiations between the city and the road. There has been a deadlock for two years over a mile and a quarter. The city insists that the company shall pave with block paving from curb to curb. It is a loop through a residence district, and the company refuses. He thought there should be a right of appeal to an unprejudiced tribunal on such questions.

LARGE STREET RAILWAY PURCHASE IN PITTSBURG.

Messrs. Alexander Brown & Sons, of Baltimore, representing a syndicate of Baltimore, London, New York, Philadelphia and Pittsburg capitalists, have consummated the purchase of all the stock of the United Traction Company, of Pittsburg, amounting to $20,000,000, of which $3,000,000 is preferred stock and $17,000,000 common stock. This will give them control of the largest street railway system in Pittsburg and Allegheny, owning and operating over 117 m..es of electric lines.

The United Traction Company is a consolidation, effected about the 1st of July last, of all the lines formerly owned and operated by the Second Avenue Traction Company, running through some of the principal streets of Pittsburg, and connecting that city with various suburbs. It controls the only access by street railway to Pittsburg on both sides of the river from the valley of the Monongahela.

The consolidation also included all the lines formerly owned and operated by the Pittsburg, Allegheny & Manchester Traction Company and the Federal Street & Pleasant Valley Passenger Railway Company, comprising practically all the lines in the City of Allegheny.

The earnings of the United Traction Company for the four months it has been in operation—July, August, September and October—amounted to $501,295.78. The operating expenses, including taxes and insurance, were $248,538.29, leaving net earnings of $252,757.49. The pro rata fixed charges were $166,433.34, leaving a surplus of $86,325.15.

WASHINGTON TROLLEY CONDUIT OPERATIVE WHEN FLOODED.

The behavior during flood times of an electric street railway, operated on the General Electric open conduit system, such as the Metropolitan Traction Co., of New York, is so extensively laying down, is of interest to the public. Ignorance of it has formed one of the principal motives for decrying it. While no flooding of the conduit has ever occurred on the Lenox avenue line, it has been averred that, if it were flooded, traffic would necessarily stop, owing to short circuit, until the water had been run off. That this is not the case is shown by an interesting experience on the line of the Metropolitan Traction Co. in Washington, D. C.

October 9, 1897, as the result of a heavy rain storm a stretch of track, some 150 feet long on the F street line, became completely flooded, the water filling and overflowing the conduit as it was unable to run off by the usual sewer connection, which was cut off. According to the statement of Mr. Weaver, president of the road, although the conduit was completely filled with water for nearly two hours, the station was not short circuited, nor were the water rheostats called into requisition. The normal load of the feeder for the section is 300 amperes; the load during the time the conduit was flooded was 600 amperes, and the cars were also operated on the sections on both sides of that which was under water. The water was practically pure, and this partially accounts for the small additional load.

The Washington electrical conduit system, although its conduit has been several times flooded, has never yet been tied up, except once, when the water almost covered the floors of the cars and flooded the motors. At other times the line has been operated by means of reducing rheostat. The present instance is the only one in which the flooded section has been operated directly from the generators without reducing medium. It was estimated that the pressure of the current on the cars in the center of the flooded portion was about 250 volts.

ENGLISH STEEL RAILS AT $125.

In tearing up a siding on the Straitsville division of the Baltimore & Ohio Railroad the other day the section men discovered that several of the rails had been made in 1863. Subsequent investigation revealed the fact that these rails were part of a lot that were bought in England during the war at a cost of $125 per ton in gold. The rails were still in very fair condition and for light motive power would last ten years longer.

GRAND RAPIDS, MICH.—During a recent celebration there was a night spectacle, and the display of the Consolidated Street Railway Company was an entire parade by itself. At the head there was a tower in pink and green, banded with incandescents. Behind this walked in single file twenty-five men bearing aloft torches of grouped incandescents, the lights arranged on a continuous circuit from the tower to the palace car in white and lavender following. The car was "a dream in electrical effects." Mirrors on the sides were arranged in panel, form, the columns between being in lavender. The general tone was white, heightened by the light of the scores of glowing incandescents.

BAMBERG, GERMANY.—A most successful trial was made on the 22d of October of the new electrical street railway of Bamberg, Germany. The trial was made before a royal commission of experts from Munich, Nurnberg and Bayreuth, and the performance of the cars under difficult conditions up steep grades and around sharp curves evoked the hearty approval of the judges. A particular feature of the trial was the application of the electric brake. In speaking of the occasion the local newspaper the "Bamberger Neueste Nachrichten," says: "Through these trials the electrical equipment of our railway has proved the fine workmanship and technical knowledge of its building. The cars are equipped throughout by Walker Company of Cleveland, whose apparatus has achieved remarkable popularity abroad as well as at home.

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TWENTY-FIVE YEARS OF ELECTRICAL PROGRESS.

WE congratulate our esteemed contemporary, the London "Electrical Review," on the twenty-fifth anniversary of its publication, which occasion it has just celebrated by the issuance of a splendid extra number. The principal articles in this issue are in part from the pens of leaders in various departments of electrical work or literature, and each gives in brief compass a retrospect of twenty-five years' work in the writer's chosen department. These articles are interesting and they present almost without exception an array of facts denoting progress on every hand in the application of electricity. They come from Englishmen, with perhaps one or two exceptions, and we cannot help noting in some cases a vein of belittlement of the work of other nations, while sundry sly digs at America are hardly compensated by the forced acknowledgments demanded and yielded by the honest recorder. But, aside from this, there is much of interest and value from a historical standpoint in the articles referred to. Mr. J. W. Swan, who devotes himself to incandescent lighting, points out that the incandescent lamp owes much to Sprengel, the inventor of the air pump bearing his name, and he passes rapidly in review the work of Grove, Starr and Staite, whose attempts at incandescent lighting proved abortive. Strange to say, we see absolutely no mention of the name of Mr. Edison, so far as relates to the incandescent lamp proper, the author glossing over that period of stress and storm in the late seventies by stating that "the experimental work which had been actively carried on both here and in America since 1877 culminated in 1880 in the establishment of the incandescent lamp manufacture on a commercial basis." This is small recognition, indeed, for Mr. Edison, but one is inclined to be charitable toward this remissness in view of the claims which Mr. Swan himself has made for the invention of the incandescent lamp, and of the fact also that he has excluded his own name from the record. We are glad to note, however, that Mr. Edison is given credit for the bold experiment of attempting incandescent lighting from central stations as embodied in the first New York Edison station. Mr. Swan also believes that the storage battery aided materially in the introduction of incandescent lighting in the earlier stages of its progress, and we are inclined to share that opinion also. By improved methods of manufacture, the efficiency of the incandescent lamp, according to Mr. Swan, has been increased 25 per cent. We believe this estimate somewhat low, considering that whereas in the earlier stages only from 6 to 8 lamps were guaranteed to the horse power, twelve 16 c. p. lamps and more are now regularly obtained. As to the total number of incandescent lamps now in daily use the world over, Mr. Swan, on the authority of one "close in touch with the commercial side of the lamp industry," states it to be 50,000,000 lamps, on a basis of eight candles per lamp. We doubt very much if his estimate is correct; indeed, we are pretty well convinced that it is a great deal below the actual facts, considering that in the United States alone there are in operation between fifteen and twenty million lamps, which, on the eight candle basis, would amount to from thirty to forty million, leaving only twenty million, at the outside for the rest of the world.

The progress in dynamo electric machinery is very ably handled by Mr. W. B. Esson, who points out that in celebrating its twenty-fifth anniversary our contemporary likewise celebrates the same anniversary of the Gramme dynamo, for it was in 1872 that this machine took practical shape. While giving due credit to Pacinotti, Mr. Esson holds that until Gramme brought his mechanical genius to bear upon it Pacinotti's machine remained but a scientific toy. With all its faults, the Gramme machine, according to Mr. Esson, was better than many of its followers, while as to the Gramme ring itself, though greatly improved from a mechanical point of view and greatly modified as to proportion it is to the lasting credit of Gramme that it remains the machine introduced by him twenty-five years ago. It was in 1872 also that the Von Hefner-Alteneck machine made its appearance in Germany, having the well known Siemens drum armature. To the Brush machine, Mr. Esson gives unstinted praise as having imparted an immense impetus to electric lighting, and Mr. Esson avers that it is doubtful if, for arc lighting in series, it has ever been beaten. As regards alternating current machines, it is pointed out that the Lontin machine of 1875, with its radial poles, finds its successor in that of Ganz & Co., the only one of this type surviving to the present day. As to the improvements in the design of dynamo electric machinery, due recognition is given to Kapp and to Hopkinson, who provided a rational foundation for, and secured acceptance of, the magnetic circuit idea as the fundamental principle of design. The main difference, Mr. Esson points out, between the earliest machines and the latest lies in making the weight of the iron greater relatively to the weight of the copper, shortening the magnetic circuit and increasing its area so as to get better results from a given magnetizing force. Mr. Esson, in closing his interesting review, bewails the reluctance of English electrical engineers to adopt, or rather their ignorance of the advantages of, polyphase currents in motor driving. He believes, in fact, that it is perfectly safe to predict that within the next ten years the direct current motor will have granted first place even for workshop power transmission to its more attractive rival. We shall see.

Articles of similar nature appear on "Secondary Batteries," by Mr. L. Epstein; "Electrical Instrument Making," by Mr. W. A. Price; "Electro-Chemistry and Electro-Metallurgy," by Mr. Emile Andreoli. Taking up one of the many remarkable advances in this latter department we need only refer to aluminum, the "precious metal" of twenty-five years ago, which fetched $340 per pound, and even more, while to-day it can be bought for less than 50 cents. How Bunsen and St. Claire-Deville would stare at the figures of to-day!

Among the other articles of a like nature, though not strictly electrical, is one by Mr. J. S. Raworth on the "Steam Engine." Indeed, the author has, to a more than ordinary degree, given free scope to his witty and not less caustic style. If necessity is the mother of invention, says Mr. Raworth, it is difficult to explain how, in the United States, where nature has done so much for man in providing him with abundance of food, such wonderful developments of invention could have been brought about in utilitarian and labor-saving devices. The fact is, says Mr. Raworth, that invention requires money, or, what is the same thing, unemployed labor to turn it to account. As to the steam engine itself, Mr. Raworth believes that while the steam engine has been doing much for man, man has done very little for the steam engine; so little, indeed, that he could scarcely have done less. As to the actual progress of the last twenty-five years, while the number of steam engines in use has increased enormously the development has been in the direction of mechanical details, and in overcoming the practical difficulties arising out of increasing pressures and speeds. Unstinted praise is given to Geo. H. Corliss, who obtained his United States patent in 1849, though it was more than twenty years afterward before the Corliss engine was introduced into England, which makes Mr. Raworth exclaim that if Mr. Tom Montgomery or Mr. Henry Edmunds had flourished in those days, England would not have had to wait some twenty years for a participation in the fruits of Corliss's genius. According to Mr. Raworth, the Corliss engine has conquered the world more on account of its excellent governing; its economical features have, so to speak, been thrown in. This is rather a queer way to put it, but we will not dispute the point with Mr. Raworth. The Willans engine is also singled out for particular praise, and we are told that American imitations of this engine have failed even when we made Chinese copies of the Willans engine. This is strange news, indeed, and we would very much like to have Mr. Raworth quote chapter and verse on this point.

We might continue in similar strain on other contributions in this eminently interesting and instructive issue of our contemporary, but enough has been said to indicate that there is real cause for rejoicing and that our contemporary has cele-

brated its twenty-fifth birthday in a manner eminently befitting the occasion. Will the art show an equal advance in our contemporary's next twenty-five years?

THE ANNUAL REPORT OF THE WEST END COMPANY, BOSTON.

ANNUAL reports are apt to be very dry reading and unsatisfactory, especially to the stockholders when the balance is on the wrong side of the ledger account. But a pleasing contrast to this is exhibited in the annual report of the West End Street Railway Co., of Boston, for the year ending September 30, 1897. Boston, it will be remembered, was the first of the large cities of the Union to adopt electric traction, due in a large measure to the indomitable energy and courage of Mr. H. M. Whitney, until recently president of the West End Company. We do not propose to enter into a detailed account of the company's financial operations for the year, further than to state that the net earnings of $2,505,323 showed an increase of $497,984 over those of the preceding year; and after paying fixed charges of no less than $880,375, there was still enough left to pay an 8 per cent. dividend on the preferred stock and 7½ per cent. on the common stock; this, it must be borne in mind, on $15,485,000 of stocks and $10,945,000 of bonds. This is a remarkable showing in every way, considering the fact, as pointed out in the report, that the spring and summer months were quite unfavorable for the usual pleasure riding during the day and evening, and also in view of the fact that much interruption to traffic was caused during the building of the subway. The latter, by the way, now serves as a relief route for 7 per cent. of the total traffic. The passenger car mileage for the year was 29,786,936, an increase of 3,945,029 over the preceding year. The number of revenue passengers carried was 172,554,513, an increase of 5,692,225; the free transfers aggregated 23,777,726, an increase of 6,211,365. The number of employés in all departments is 5,095.

In looking over the figures one is particularly struck by the fact that, notwithstanding the increased traffic, a number of the principal items classed under operating expenses have decreased. Thus, under the head of maintenance of track we notice a decrease of cost over the year preceding of $107,337. The total charge under this head is $831,411, which sum includes the rebuilding of 19 miles of track with 95 pound girder rail at a cost of $241,406. We notice also that notwithstanding a net addition of 118 car bodies, 450 motors, 334 trucks, and of 50 sets of controllers, the cost of maintenance for both cars and electrical equipment has been decreased, for the former, nearly 70 per cent., and for the latter, 30 per cent. The actual number of motors owned by the company is no fewer than 3,121. In contemplating these figures, one cannot but believe that much of this decreased cost of maintenance is due to the improved condition of the company's tracks. Of the total 304 miles of track owned by the company, 223 miles are now laid with heavy girder rails up to 100 pounds per yard, while in no case is less than 70 pounds used. These figures speak for themselves and must do much towards still further strengthening the confidence of investors in the earning capacity of properly equipped and carefully managed electric railway properties. That such confidence is placed in the West End Company is shown by the fact that the company's shares are held by 7,089 stockholders, of whom actually 3,870, or more than one half, are women. The shareholders are distributed over 31 States from Maine to California, and some shares are held in foreign countries.

FIRE ALARM SYSTEMS IN ENGLAND.

LONDON has somehow always been as noted for its fires as though it were a dried up Western prairie city instead of being permanently soaked in fog and rain; and it appears to have no intention of change in this respect. A fire in London on November 19 destroyed nearly one hundred and fifty warehouses. The loss will probably exceed $8,000,000. For four hours and a half the flames had their own way, and it was only after more than a hundred engines had worked an hour that the fire was under control. Fifty engines were pouring tons of water upon the ruins. Hamsell street, near the General Postoffice, was the scene of the outbreak of the fire, which was due to an explosion in connection with a gas engine. The most curious reports are current as to the delay of the fire brigades in reaching the spot. We quote as follows: "The policeman who first saw the flames, when the gas engine exploded, blew his whistle loudly for assistance, but blast after blast failed to reach the ears for which they were intended. He did not dare to leave his post, and he had no other means of giving the alarm but with his penny whistle. Several minutes passed before the cry for help was heard. When aid did come, the first policeman was despatched to summon the fire brigade."

Then the despatch goes on to say: "It was twenty minutes after the policeman first blew his whistle before the first fire engine appeared. The delay was unaccountable."

This picture is Chinese in its adherence to old customs and its ludicrous inadequacy of methods for meeting such an emergency. One doubts its accuracy.

But if true, what a severe indictment against the city authorities? Can it be that the greatest city in the world is still satisfied with blowing ineffective whistles when American keyless signal boxes would bring engines to the scene in literally a few seconds? It is alleged that the men were inefficient when they got to the fire, and did poor work. Let it be conceded that like most fire fighters they worked bravely and well. What are we to think of a system that allows a fire in one of the most dangerous sections of a crowded city to rage unchecked for twenty minutes, with fire stations all about? We are puzzled by the reports, for we believed London to have alarm boxes; but if they are installed they certainly were not used.

Any one who is familiar with American systems and goes abroad is struck with the average slowness and slackness of dealing with fires in Europe; and when reports are made that Europe equals America in this respect the only thing to do is to dismiss such statements with the silent contempt they deserve. At the same time the London fire is a warning for large American cities to keep their fire alarm apparatus up to date. Only the other day, there was a pretty little investigation in New York City tending to exhibit the fire alarm apparatus as by no means up to the times or even up to the standard of other cities; and it may be hoped that the many possible improvements then indicated have been made. If a good fire got a-going in New York, the $10,000,000 damage in London would appear small.

SUBMARINE CABLE LAYING AROUND NEW YORK.

THE Commercial Cable Co. has been engaged the past week in laying cable for ship news, etc., at the entrance to New York harbor, thus adding quite largely to its system in this part of the world. A few years ago, it will be remembered, the Mackay-Bennett laid cable to Coney Island and right up to the Battery on the southern tip of Manhattan Island, and she has now interlaced that with similar work around Sandy Hook, giving the Commercial Co. a good marine news service. We cannot help wondering whether this may not be the closing scene of submarine cable work at this point. If the new Marconi system is worth anything, it should be useful at just such locations as the sea gate of New York, and it does seems as though a little experimentation would be in order. Submarine cable operations are very expensive, and there is always the condition that ships may pass signaling points in the night or in heavy mist and fog. At such times, ships carrying radiators with a not so very big spark coil could throw their news report across ten or twelve miles of sea confident that they would be heard. In the same way, as has already been proposed, lightships could communicate with the shore—say the Scotland light with Navesink Highlands. The apparatus is not very costly, and would be a valuable adjunct. Steamers not carrying it, would still take the old chances; those with it would gain a new means of safety and wireless intercommunication. This may not come all at once, but as a practical tendency in the near future it holds out large promise.

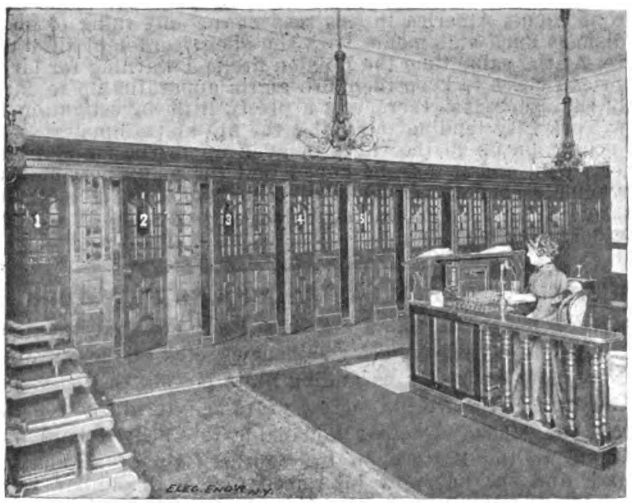
STATE RAILWAYS IN GERMANY.

ATTENTION was recently called in these columns to the data in regard to German State railways, showing how inefficient and costly their service was and how it hindered traffic in various ways. A few official statistics on the number of accidents are not more reassuring. According to these figures there were, during the month of September of this year, on all German lines, exclusive of Bavaria, 31 derailments, 24 collisions, and 163 smaller accidents, 50 people being killed and 135 wounded. When it is remembered that only two or three of the most important lines run more than two express trains in twenty-four hours, this record of two bad accidents a day is a terrible one. We commend it to the consideration of those who are agitating for State control of American railways and municipal ownership of street car lines.

TELEPHONY AND TELEGRAPHY

NEW CENTRAL QUARTERS FOR TELEPHONE PAY STATIONS, NEW YORK CITY.

As everybody knows, the "pay station" business of the New York Telephone Co. has enjoyed an immense development during the last few years, there being now no fewer than 2,200 such pay stations, and the provision for its care has been steadily increasing. It will be remembered that in the old telephone building on Cortlandt street a large and handsome room was occupied on the ground floor by the pay station department for local and long distance work. Recently the New York Telephone Co., on removing to its fine new building in Dey street, has cut a hall or arcade clean through the block, so that the two buildings are practically one for all purpose of traffic and intercommunication. The arcade having wiped out of existence the pay station room, it was



Public Local and Long Distance Telephone Pay Station, Cortlandt and Dey Streets, New York City.

necessary to lay out other quarters, just as convenient, and this has now been done. We illustrate herewith the new room, which lies right along the arcade, and is on the west or Hudson river side as one passes through the hallway between Cortlandt and Dey streets. It is fenced in by large clear glass windows, giving full view within the room, and is entered at either end by double swinging doors. Within the room the operator in charge has her desk in the center, giving her switchboard command of each and all of the ten private booths ranged along the west wall. When a customer enters a booth he is given the connection he wants and the incandescent light within the booth is automatically switched in. When the conversation is over and the customer leaves the booth the light is automatically switched out and settlement for the service is made at the operator's desk. The room has a corps of civil attendants, and is equipped with writing materials and a file of the daily newspapers, so that time spent in waiting can be agreeably or usefully employed. All exterior noise is excluded, no noise is heard within the room and each telephone booth is sound proof with double doors. The office is in reality quite tasteful and pretty in its furnishings, and the approach is, as stated, through the arcade, lined with Numidian marble, and promising to become at no distant date one of the most important interior thoroughfares in the busy city of New York.

LAYING COMMERCIAL CO.'S NEWS CABLE OFF SANDY HOOK.

The work of laying the new marine cables for the Commercial Cable Company, which are intended to supply the latest information of the sighting of ships off Fire Island, the Highlands of Navesink, Sandy Hook and Quarantine, is progressing very satisfactorily. The cable steamer Mackay-Bennett left the upper bay last Friday morning to continue the work which she began Tuesday. A number of officials from the Commercial Company, including Vice-President and General Manager George G. Ward; President of the Postal Telegraph Company A. B. Chandler, E. C. Bradley, second vice-president, and Charles Cuttriss, chief electrician of the Commercial Company, watched the work.

Four of the strongest and latest types of cables made by Siemens Bros. are to be laid for this marine news plant. On Wednesday the Mackay-Bennett ran one line of the cable from the hut on Coney Island for three miles in the direction of Sandy Hook and buoyed it. Tuesday, Nov. 23, she started from Sandy Hook with another line, and this she ran off in the direction of Coney Island for three miles, also buoying the end. On Friday the ship laid the section of four miles between the two buoys, after which she picked up the buoyed ends and spliced them. When the Coney Island-Sandy Hook cable is finished the Mackay-Bennett will run a second cable from Coney Island to Fire Island, a third from Sandy Hook to the Highlands of Navesink, and a fourth from Sandy Hook to the Quarantine grounds on Staten Island.

It is not often that the opportunity is presented of seeing a submarine cable laid and spliced, and a great many electrical people made the most of the occasion, the daily newspapers also spreading themselves in graphic articles on the subject.

MARCONI WIRELESS TELEGRAPHY IN AMERICA.

Mr. W. J. Clarke, the popular lecturer on electricity and other kindred topics, has been taking a deep interest in the Marconi wireless telegraph and has been very successful in operating the system, basing his apparatus on the general descriptions that have reached this country, and employing the Hertz radiator with the Marconi or Branly coherer. Mr. Clarke some weeks ago made a preliminary test in his office at 120 Liberty street, New York, and succeeded in starting up a small motor placed across the hall in the offices of The Electrical Engineer; using a couple of coherers to close the motor local circuit. He also has made since experiments at Lancaster, Pa., etc., and on Thanksgiving eve gave a beautiful demonstration in New York at the residence of Mr. Jacob Schiff, the well known banker, as part of a program of the latest things in electricity. The radiator was placed in the picture gallery and the receiver was put in the drawing room some feet away on the same floor of the house. Mr. Clarke had a special apparatus built by J. H. Bunnell & Co., with one little coherer mounted in front, and closing the circuit on the battery and a sensitive relay on the same board. Signals were sent over and through a party of 24 guests and were sharp and clean cut to a degree. Prof. Morris Loeb, of the University of New York, one of the guests, and Mr. T. C. Martin, who was explaining other new things, witnessed and participated in this very pretty and successful test, the first public demonstration, it is believed, of the Marconi system in this country. Mr. Clarke is now pursuing this line of work and making tests at long range, believing that many experimenters, colleges, etc., will be glad to secure outfits to continue the new work themselves.

TELEPHONE COMPETITION FOR NEW YORK CITY.

A special dispatch from Detroit of November 26 says: President William L. Holmes, of the new Detroit Telephone Company, who recently returned from New York, says that a party of capitalists who are about to organize an independent telephone company in Greater New York, are negotiating for the use of the Detroit apparatus for the New York exchange. Mr. Holmes would not give the names of the promoters of the New York company, but he says that they are prepared to invest $15,000,000 at once in a 50,000-instrument telephone exchange for Greater New York, and that they would expect to add largely to that number later. Their plan contemplates the establishment of local stations and toll lines in every city of New York State in opposition to the Bell Company.

The new telephone company about to begin operations in this city is the Citizens' Telephone Company, of New York and New Jersey. D. A. Reynolds, its secretary, says that this is undoubtedly the concern to which William L. Holmes, president of the Detroit Telephone Company, referred.

The Citizens' Company has executive offices in the New York Life Insurance Building, but does not expect to apply for a franchise before the 1st of January, after which time the work of extending its apparatus and extending its system will be actively pushed.

According to Mr. Reynolds, there will be a heavy cut in rates, and the charges of the new company will be, on an average, not more than 40 per cent. of those now in vogue.

The officers of the Citizens' Telephone Company are: President, E. K. Sumerville; vice-president, Charles L. Wright; treasurer, Richard P. Messiter; secretary, D. A. Reynolds. The chief electrician will be Edward P. Trayer.

NEWS AND NOTES

THE MAXIM HIGH RESISTANCE THICK FILAMENT LAMP.

SOME weeks ago we commented briefly on a cable dispatch announcing a new lamp invented by Mr. Hiram S. Maxim, of London. Some extraordinary claims were made for this incandescent lamp.

In a letter referring to the new lamp, appearing in the London "Electrician," Mr. Maxim gives the following information regarding his latest invention:

I would say that all the reports that have appeared in the American and English press regarding my experiments with electric lamps have come from a single source. An American newspaper reporter came to interview me. He said he had heard I was doing something with lamps. I said: "It is quite true that I am experimenting, but as yet I have no particulars to give. However, the lamp which is lighting this room, and which has displaced three 16 c. p. lamps, is 42 c. p. When this lamp was made it was found to give a candle power for considerably less than two watts, whereas the ordinary lamp takes at least four. I did not believe the lamp would last two hours; however, we put it on, and this was a long time ago, and the lamp is still running and is of great brilliancy and quite clean. If I were sure of being able to make lamps like this, in large quantities, the process would be worth a lot of money, but so far I have not advanced far enough to show the lamp to the public. I am running a number of lamps in a large room upstairs, and some have been running 1,000 hours." As to the lamp in question, when it was put on it was 42 c. p.; about two months later it was found to be 52 c. p. However, it has commenced to go off, and when last tested was 41 c. p., which would seem to indicate that it is not going to last forever after all.

What I have been attempting to do is to produce a lamp in which a very high resistance might be obtained with a short and thick filament, also to produce a filament which will stand a higher temperature than those ordinarily used, as it is well known that a slight rise in the temperature greatly augments the light given in proportion to the current used, but the preparation of the carbon and other materials which form the filament requires a very expensive apparatus. The cost, however, of the finished filament—excepting first cost of plant—is no greater than with the ordinary lamps.

I have tested the new lamps in competition with all the best lamps I could find, and there is no question but what they show a very marked saving in electrical current, and this, of course, is the object aimed at after all. I have not decided as yet whether to keep the process a secret or to patent it.

MR. E. D. ADAMS' COMMENTS ON THE EUROPEAN OUTLOOK.

E. D. Adams, late chairman of the Board of Directors of the Northern Pacific Railway Company, returned a few days ago from a five weeks' trip to Europe. The following is the substance of some of his keen and shrewd observations as given to a representative of the "Evening Post."

England he found to be greatly hampered by the tyranny of the trades unions. The engineers' strike was much more important than appeared from the name. In England engineering includes almost all kinds of constructive work, such as the erection of buildings, railway building, the building of ships, the making of machinery and a variety of other avocations. Trades unionism now makes such pretensions that the important question in England is whether capital shall be controlled by those who own it or by the men whom it employs. Many orders for machinery received from the colonies have been sent to Belgium and Germany because they cannot be executed in England. A phrase of great significance that has been so frequently noted is "made in Germany." In fact, German goods appear to be pushing English manufactures hard in England itself and all the markets of the world.

In Germany there is a great development of the industrial spirit. The railways are mainly owned by the government, and in the interior of the country the only avenues for the investment of capital are found in manufacturing. The old universities which formerly shaped their courses of study with a view solely to the training of the mind now give a great deal of attention to practical training in engineering, chemistry, mining, electricity and applied science of all kinds, and this is in response to a general national demand which insists that the schools shall turn out men fully equipped for the business of modern life. The Germans have taken up with great intelligence the matter of the application of electricity to manufacturing and transportation. In all directions their effort is to cheapen the cost of production by the utilization of bi-products, and by a very close study of minor economies. As an example of these economies, Mr. Adams says that the tall chimneys of the factories have tanks of water built around them, so that the heat of the chimneys will raise the temperature of the water before it is used in the boilers.

FIRE DAMAGES PLANT OF THE UNITED STATES ELECTRIC LIGHTING CO., WASHINGTON, D. C.

Shortly after 2 o'clock Friday morning, November 26, fire was discovered behind the immense controlling switchboard of the United States Electric Lighting Company's station, in Washington, damaging many costly pieces of apparatus before the fire was extinguished. The switchboard was of wood, being mounted on a gallery at one end of the building devoted to the incandescent lighting machines. The cause of the fire is attributed to a short circuit, between the switchboard and the brick backing, which separates it from one of the offices of the company. This board controlled the entire direct current incandescent service supplied by 16 Edison bipolar generators, ranging from 60 k. w. to 200 k. w each, feeding a total of 25,000 lamps. Four 60 k. w. Edison bipolar generators, supplying power for the Washington, Alexandria & Mt. Vernon Railroad, whose switchboard was practically uninjured, were the only direct current machines, with the exception of the arc dynamos, not put out of service.

While the loss to the building, switchboard, rheostats and feeders amounts to considerable, not more than four or five generators were damaged, with the temporary disablement of one or two engines. Owing to steel "I" beams which support the cables under an iron sheathed roof, the systems of distribution of the alternators, and arc machines, were practically undisturbed. A new switchboard of temporary character was immediately built and installed, the apparently hopeless snarl of wires and feeders being skilfully replaced by new conductors and put in use the evening following the fire. Among the institutions dependent upon this work before nightfall can be mentioned the National, Academy, Albaugh's and Kernan's theatres, not to speak of the various clubs, residences and shops included in the distribution of the Edison three-wire system. This is the second power station fire in Washington this fall.

MUNICIPAL AFFAIRS

MUNICIPAL PLANT FOR GRAND FORKS, N. D.

W. I. Gray & Co., of Minneapolis, have been awarded the contract for putting in a municipal electric light plant for the city at a cost of $12,703. The building and all will cost a little over $15,000. The council had a bitter fight over the matter, and restraining injunctions are to be served on city officials.

A MUNICIPAL PLANT FOR CUMBERLAND, WIS.

The Cumberland city council has voted to put in an electric lighting system at once, and has levied a direct tax to cover expenses. Work will begin at once on the plant.

HUDSON COUNTY, N. J., TIRED OF ITS OWN LIGHTING.

The Hudson county, N. J., Board of Freeholders has decided to light the Hudson Boulevard by contract instead of maintaining the costly electric light plant now in operation. Numerous complaints regarding the inefficiency of the county employés in charge of the plant and of frequent breaking down of the machinery have been made. The plant, which is located at Snake Hill, has cost the county nearly $100,000.

THE PLANT FOR CUMBERLAND, MD.

Cumberland, Md., has rejected all the bids for its proposed municipal plant, and will ask for new ones. Frank B. Rae, the electrical engineer, of Chicago, who drew up the old specifications, will commence work at once on the new.

The bids were made in five divisions, and because of the

great entanglement were rejected. The specifications, too, were indefinite, but now the committee knows exactly what is wanted, and the new plans will be made out accordingly. Numerous bids were submitted, among the bidders being Thos. C. Basshor & Co., Maryland Manufacturing and Construction Company, Crook, Horner & Co., and McKay Howard Engineering Company, all of Baltimore. The new plant complete is not to cost over $20,000, the city having voted to issue bonds to that amount.

DISCUSSION OF COST OF SERVICE.

Mayor MacVicar is engaged in preparing a reply to Allen Ripley Foote, a member of the American Economic Association, who read a paper before the League of American Municipalities at Columbus, O., entitled, "Cost of Service to Users and Taxpayers; A Proper Basis for Comparison Between Private and Municipal Ownership of water, Gas and Electric Lighting Works." Mr. Foote's paper was in effect an argument against municipal ownership. He requested Mayor MacVicar to study the paper and indicate what parts of it were not based on sound logic, and the mayor is complying with the request. Mr. Foote claims that it is unsafe to go further with municipal ownership until complete statistics are obtained from the cities of the country, showing what municipal ownership has accomplished where it has been tried. Mayor MacVicar disagrees with this view, and also disagrees with many other of Mr. Foote's conclusions.—Des Moines Leader.

PROPOSED CITY PLANT FOR WEST SUPERIOR, WIS.

There is pending before the city council a resolution notifying the Water, Light and Power Company that at the expiration of the lighting contract in January the city will not renew. Contracts for 100 street lights, which have been running five years, expire. A committee is to determine the cost of a lighting plant owned by the city.

THE NEW CITY PLANT AT ROCK RAPIDS, IA.

The new electric light plant on which work was commenced last May has been completed, and the lights turned on. Nearly 1,800 lights have been installed, which, with the thirty-two arc lamps on the streets, takes up the capacity of the plant. The system is the Edison three-wire; both arcs and incandescent lamps being run from the same wires. Bare wire is used on the outside conductors, and the line work required nearly 23,000 pounds of copper. The plans were made by W. I. Gray, of Minneapolis, and the contract awarded to M. I. Bigelow, of Lincoln, Neb. The final test will be made in a few days, and the plant turned over to the city.

THE COMPARATIVE COST OF STEAM AND ELECTRIC POWER.—II.

BY IRVING A. TAYLOR.

THERE are certain industries where the total power used all day, and throughout the year, will not vary much from an average amount, and the load factor taken throughout the year will be a high one, providing that the plant is properly designed. For this class of work mechanical methods of transmission may often be more economical than electrical ones, though it must be said that they are seldom as convenient. A large class of power users, however, make a demand for their total power in such an irregular manner that if their power consumption is plotted as a curve over a single day, or, more especially, over a year, it will be found to vary between such wide limits that the ratio of the average load to the maximum, that is, the load factor, is extremely small and this is so in spite of the condition previously mentioned, that a large portion of the machinery may be so arranged, in sections, that each section shall use a nearly constant amount of power when it is operating, for the simple reason that the general use of the various sections of machinery is very intermittent, and that very busy and very quiet times are almost certain to prevail at different seasons of the year.

This state of affairs is productive of two results, both of which are favorable to the use of electricity, in one case, as a power transmitter, and in the other as a prime mover.

Taking the first case, suppose we have a large establishment with a 1,000 h. p. engine which, at full load, delivers 750 h. p. to the machinery and 250 h. p. to the various mechanical transmitters; the efficiency here is 75 per cent., which is fairly high. But if the yearly load factor is 35 per cent., not a very low one, by the way, for the class of work under discussion, the useful work is only 10-35 of the total amount, or, in other words, 28.6 per cent. The use of electrical transmission, on the other hand, would give about the same total efficiency, from the engine pulley to the driven machinery, of 75 per cent., at full load; but with the actual load factor which we have assumed, the total efficiency would be between 50 and 60 per cent., or double that for mechanical transmission; so that, though it would be necessary to retain the 1,000 h. p. steam plant in order to carry the maximum load, the saving in coal and water would be between 30 and 40 per cent.

In a non-condensing plant, keeping the load factor in mind, this would mean at least $2,000 to $3,000 per year on the coal bill alone, with coal at $3 per ton. This is sufficient to cover the extra charges on the electrical machinery, and leave the belting and shafting not needed, and the enormous convenience of the electrical method, a pure gain. This is only a general case; in particular cases there are usually a number of special circumstances which if properly taken advantage of, will make it possible to reduce the main plant by at least 25 per cent., with all that that means.

In the plant which we have been considering, as indeed in any plant, it is evident that there will be certain charges independent of the load factor, such as interest, depreciation, labor, rent, and, to some extent, the coal and water used; while there will be other charges which will vary almost directly with the load, such as most of the coal and water costs. Put in another way, the "constant" charges, when reckoned per horse power hour, will be variable ones, and will vary inversely as the load factor; while the "variable" charges when reckoned per horse power hour will be independent of the load factor.

Suppose the constant charges on a plant are $5,000 per year, and the variable charges are also $5,000 per year at full load. If the load factor now becomes 50 per cent., the constant charges remain the same, while the variable ones are reduced nearly 50 per cent. If this plant delivers, at full load, half a million h. p. hours per year the constant charges per h. p. hour will be 1 cent, as will also the variable charges. With the load factor, as before, at 50 per cent., there will be 250,000 h. p. hours delivered per year, which will make the constant charges, reckoned per h. p. hour, vary to 2 cents; while the variable charges, which, as we have seen before, will have been reduced to nearly $2,500, will still be about 1 cent per h. p. hour, and the resulting cost of a h. p. hour will have risen from 2 cents to 3 cents.

It is apparent from this that the more nearly the total costs are made up of variable ones, the higher will be the economy, and the less will be the cost per h. p. hour on low load factors, while with these low factors the economy will be lower, and the cost per h. p. hour will be higher, when the constant charges form a large proportion of the total costs.

Now it is a well known fact that, as steam engines get smaller, the constant charges on the plant become disproportionately large and make it very expensive to operate them. To overcome this difficulty central power stations, operated on various systems, have been from time to time proposed and have been operated with more or less success. A central power station, feeding a large district has two distinct advantages, the one, that it will have a much better average load factor than any one consumer separately, and the other, that the constant charges are greatly reduced, merely on account of the increased size of plant. There is, however, a constant charge, which isolated power plants do not have to meet, on a system of expensive distributing mains; and this fact has almost always been fatal to central station distribution, except in the case of small motors, where, in some instances, consumers have been willing to pay as high as 20 cents per h. p. hour.

Here again electricity has come to the fore and proved its ability to cope with special conditions and to supply power economically from a central station to scattered consumers who use electric motors as their prime movers. The reason for the success of electrical power stations over other kinds is, setting aside the question of higher efficiency, the fact that light and power are distributed over the same mains and are generated by the same machinery. On this account, anything that the motor load nets an electric central station over and above the variable charges, is a pure gain. In a large central station the variable charges on that part of the load which does not help to form the so-called "peak" of the yearly load curve, are very small, so that a moderate charge for this power nets the central station a very handsome amount. To

this reason a special bid is made for power consumers in the shape of such low prices that, were they properly understood, it would seem impossible for moderately small isolated steam powers to compete with electrical, on the score of cost alone.

DIRECT CONNECTED BULLOCK GENERATORS.

During the last five years the development of direct connected electrical apparatus has so revolutionized the old methods and types of dynamos and motors, that it is almost impossible at present to find any large electrical manufacturing concern that does not furnish machines for direct connection to engine or line shafting, and dynamos and motors of this type, especially in the larger units, are almost universally specified and required by purchasers of electrical machinery.

This rapid development has naturally caused many different designs and features to be embodied in the various machines placed before the public and from the best of these several perfected types have been evolved which contain the latest and best electrical and mechanical features, and have a beauty and symmetry of appearance that has not been equaled heretofore.

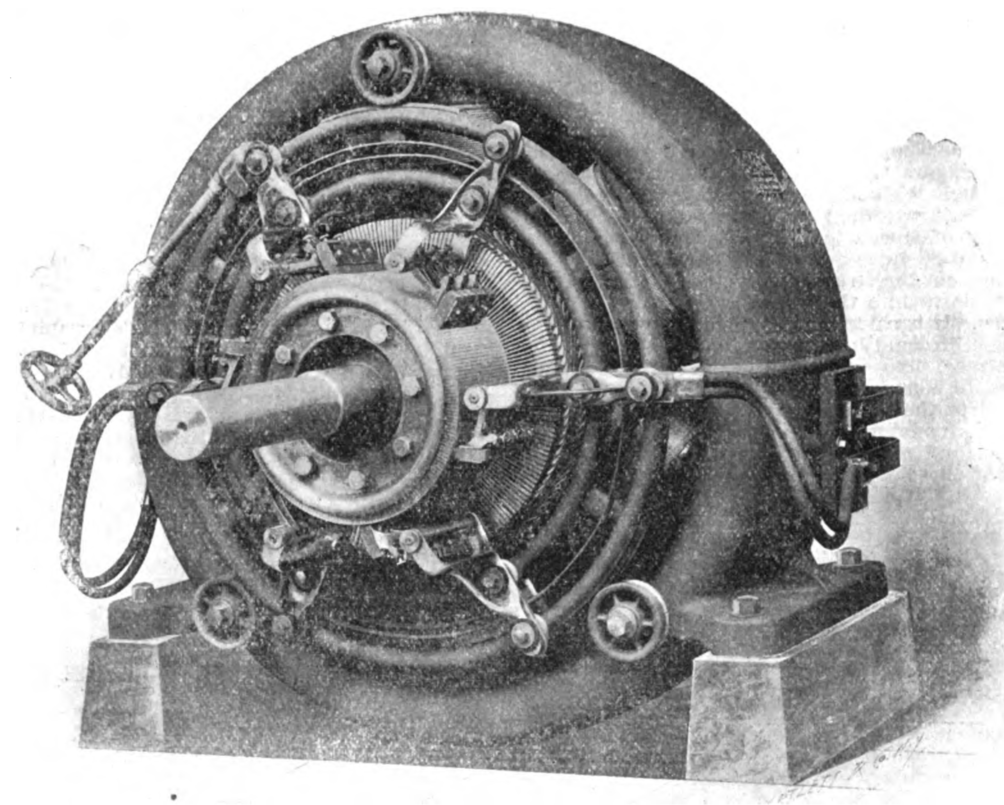
The accompanying illustration shows the latest form of direct connected multipolar apparatus manufactured by the Bullock Electric Manufacturing Co., of Cincinnati, O., embodying several radical and distinctive departures from all of the other types.

FIELD FRAME.—In order to obtain the least possible effect of stray magnetism and give the greatest amount of strength and protection to the armature and pole pieces, as well as to conform to the smallest amount of space per pound of weight, the field frames of the Bullock generator are cast in the form of an annular ring. Upon both sides of the frame are mounted the blocks for connection to the main supply feeders, making them very easy of access. The entire proportions of the field frame have been so designed as to meet the most exacting demands and at the same time present a very graceful appearance.

POLE PIECES.—The pole pieces, of which there are six in the 50 k. w. and eight in the 100 and 150 k. w. generators, are made of the finest soft laminated Norway iron and are cast directly into the annular frame ring, thus insuring perfect alignment. The field coils are machine wound on forms and can be readily removed and replaced whenever desired. The shunt and series coils being separately wound, are mutually independent and removable, and the entire arrangement is such as to give free and perfect ventilation to the poles.

ARMATURE.—The armatures are built of laminated discs of thin charcoal iron, and are of the ventilated "Iron Clad type." The coils are carried in the slots in the periphery of the armature cores and are held in position by maple wedges retained in special recesses. This relieves the armature coils from any undue pressure and makes band wires unnecessary. They are then laid in the slots in such a way that should any coil require removal it can be removed without displacing other coils than those immediately adjacent. The armature admits of thorough ventilation by means of ventilating ducts placed throughout its entire body.

COMMUTATORS.—The commutators are of large dimensions and run very cool and absolutely sparkless. They are built up of drop forged bars of the purest Lake Superior copper and are insulated from each other with selected East India mica.



THE BULLOCK ELECTRIC MFG. CO.'S DIRECT CONNECTED MULTIPOLAR GENERATOR.

BRUSH HOLDERS AND BRUSHES.—Brushes are of the carbon reaction type and the brush holders are so designed as to afford an excellent contact between them and the brushes and between the brushes and the commutator. The adjustment of the brushes as a whole is accomplished by the movement of a single lever extending from the field frame as shown in the illustration. The bearings are self-oiling and self-aligning, having great strength and rigidity.

From the foregoing it will be noted that the Bullock Electric Manufacturing Co. have succeeded in producing a very superior type of apparatus, and as only the very best workmanship and material is allowed to enter into its construction the large sales that are daily being made tend to show that the public has not been slow to recognize their progressive and enterprising spirit.

In recent exhaustive tests made by the United States Government at Finn's Point, N. J., where these generators were run in a closed vault, they carried their maximum load con-

tinuously for 5 hours and carried an overload of 50 per cent. for 1 hour and 75 per cent. overload for 15 minutes, with a rise in temperature of less than 60 degs. F., with noiseless and sparkless operation under the entire range of load and overload, and without any adjustment or shifting of the brushes. And again, at a recent test made for the engineers of the United States Navy, a 50 k. w. generator was loaded to a capacity of 75 k. w. at 125 volts, and the main line switch was rapidly opened and closed, throwing on and off the entire load several times without any sparking at the brushes or any other injurious effect.

It is because of just such facts that the factory of the Bullock Co. is working 24 hours every working day to keep abreast with its orders.

Although this type of machine has been on the market and in commercial operation for less than a year, they have already earned an enviable reputation for their makers, and put the Bullock Electric Mfg. Co. in the highest rank of electrical manufacturers of the country.

PLANS TO PROTECT THE NIAGARA RIVER.

THE Commissioners of the State Reservation at Niagara held their annual meeting on November 18, and at that time took occasion to pass a resolution empowering President Andrew H. Green to take steps to secure by an international agreement the protection of the falls and upper river at Niagara. It is generally understood that the commissioners were actuated in taking this step by a revival of interest in the scheme of the Welland Power & Supply Canal Company, which company is incorporated under the laws of the Dominion, from which government it secured its franchise rights. The plan of this company is to divert a portion of the water of the upper Niagara river from its present course and cause it to flow through Welland river or Chippewa creek to a canal that would carry it to the top of the mountain or bluff which is an extension of Queenston Heights, there to have it operate turbines installed in a power station at the foot of the mountain. At present the stream known as Welland river, or Chippewa creek, flows into the upper Niagara about two miles above the falls. It is said that by a slight deepening of the bed of the stream, it could be made to flow in the opposite direction. At Montrose, five miles from the mouth of the creek, it is proposed to commence the construction of a canal which would extend to the Niagara escarpment, or bluff, referred to above. This canal would be 14 feet deep, 100 feet wide at the bottom, and a greater width at the top. From the main power station so located it is proposed to build a canal for a tail race to the village of Homer, where a second power station would be erected. The water from this station would then reach Lake Ontario through the Ten Mile creek. Between locks 8 and 9 of the Welland canal it is proposed to build a ship canal to the main power station at Homer, so that manufacturers could receive material and ship their products by water through the Welland canal. It has been thought at Niagara that the company was dead, and that its scheme had been shelved, but it seems that the originators have been inspired to resurrect it by the attention the Dominion is receiving from foreign capitalists its gold mines.

While international protection of the Falls of Niagara has many times been suggested, this is the first public step taken looking to its preservation by the governments of the two countries, and its progress will be well worth watching.

ADDITIONAL NIAGARA POWER FOR BUFFALO.

The power transmission line from the Niagara Falls power house to Buffalo is now undergoing a considerable increase, the demand for power from Buffalo having within the past few months grown beyond the capacity of the line first put up. The three wires strung on the poles now have three companions, and the white insulators on each pole have been increased to six.

A new order for cable, as well as for transformers, has been placed with the General Electric Company. The cable is of special manufacture, is insulated to stand the ultimate pressure of the line, which will be 22,000 volts, and is tested under a considerably higher pressure before leaving the works. Twenty-four thousand feet of this cable will be used at first for that part of the transmission line within the city of Buffalo. The order for increasing transformers covers seven of similar size and design to the three already installed in the transformer house of the Niagara Falls Power Company. These ten transformers are the largest ever built. Each has a capacity of 1,250 h. p., making a total step-up transformer capacity of 10,000 h. p. They are of the air-blast type, and will stand in rows of four upon the air-tight chamber, whence the air is forced through the ventilating spaces in the transformers.

Several step-down transformers will also be placed in the station of the Buffalo General Electric Co. and from these three-phase current, converted into direct current in rotary converters, will be utilized for lighting purposes and for small power units.

The Buffalo Railway Company is also increasing its step-down transformer and rotary converter capacity in its Niagara street power house. In addition to the two 500 h. p. converters already in operation, the General Electric Co. have built two others of similar capacity and construction. These will bring the total converter capacity in the station up to 2,000 h. p. To supply these necessitates the installation of three additional step-down transformers in the transformer house between the station and the canal. These will be of about the same capacity as the three already there, each of 275 k. w., reducing three-phase current from about 10,500 volts to 375 volts for delivery to the alternating current side of the rotary converters in order that it may issue direct current at 550 volts, at which pressure it is delivered to the bus-bars of the station switchboard.

OBITUARY

ROSWELL HART ROCHESTER.

Roswell Hart Rochester, treasurer of the Western Union Telegraph Company, died suddenly on November 27 at his home in Englewood, N. J., fifty-eight years old. He was apparently in good health up to within a short time of his death, and had enjoyed a drive into the country during the afternoon of the day upon which he died. Heart trouble was the cause of his death.

Mr. Rochester belonged to the pioneer family from which Rochester, N. Y., derived the name. He was born at Gates, Monroe County, this State, on August 17, 1839. He entered the service of the Western Union Telegraph Company, April 1, 1865, as a clerk in the office in Rochester. He continued to occupy that place until the executive offices were removed to New York City, when, having discharged his duties acceptably, he became assistant treasurer, a place which was created for him at the instance of O. H. Palmer, secretary and treasurer of the company. On the election of Judge Palmer to the vice-presidency in 1871, Mr. Rochester was promoted to the treasurership of the corporation, which office he has since then held.

He was active in the financial management of many religious and charitable institutions, and had served as an executor and trustee of several estates. Mr. Rochester recently had lived at Englewood, where he had been actively connected with matters pertaining to the welfare of the community. He was a member of the Sons of the Revolution and of the Military Order of Foreign Wars. He leaves a widow and one daughter.

ENGINEERING AWARDS AT THE NASHVILLE EXPOSITION.

Among the awards announced at the Nashville Exposition are: Diploma of honor and gold medal, Chas. A. Schieren & Co., for leather belting. Diplomas of excellence, with silver medal, Clonbrock Steam Boiler Co., Morrin boilers; Hoover, Owens & Rentschler Co., steam engine; General Electric Co., electrical apparatus; Holtzer-Cabot Electric Co., electrical apparatus; James Leffel & Co., turbines; Otto Gas Engine Works, five gas engines; Phœnix Iron Works, 150 h. p. and Church engines; Western Electric Co., direct current dynamos. Diplomas of honorable mention and bronze medal: Chicago Fuse Wire Manufacturing Co., wire fuse; Lane & Bodley Co., Corliss engine; Triumph Electric Co., direct current dynamos.

COHERERS.

Prof Temistocle Calzecchi, of the Liceo of Fermo, claims priority over Branly himself in the discovery and employment of coherers. As long ago as July, 1884, he says he made known the characteristic properties of metallic filings in the pages of the "Nuovo Cimento." Subsequently, in conjunction with Prof. Auerbach, of Breslau, he employed his coherer for various practical purposes, but not, apparently, for wireless telegraphy. One of his papers was entitled, "On a new form which may be given to the Microseismic Indicator." He says in it: "A slight tremor communicated to the table holding the tube, a small tuning-fork standing on it and vibrating, and sometimes a note sung are sufficient to deprive the filings of their conductivity."

SOCIETY & CLUB NOTES

ELECTRIC GAS ENGINE PLANT AT THE CIVIL ENGINEERS' NEW SOCIETY HOUSE.

THE new house of the American Society of Civil Engineers, opened in New York last week, is provided with a complete isolated gas engine electric plant. This plant consists of two direct connected units, the engines being of the double cylinder vertical type "Nash" gas engine, running at 280 revolutions per minute, and having each a capacity of 25 brake horse power. One of these units is shown in the engraving, Fig. 1.

The water for the cylinder jackets is circulated automatically and passes through a cooling tank located in one corner of the engine room. All noise of exhaust is obviated by means of three exhaust pots, one for each engine, which the exhaust gases enter immediately on leaving cylinder, and one at the point of junction of the two engine pipes with the 7-inch exhaust pipe extending to the roof of the building. Each engine with its dynamo, is mounted upon a solid sub-base resting upon a concrete foundation. The engines are provided with electric igniters of an improved form, which have been found to be very satisfactory and reliable. The engines are direct coupled to 15 k. w. Crocker-Wheeler dynamos.

The chief difficulty with, and objection to, direct connected gas electric plants has been lack of steadiness in the lights due to explosive impulses of the engine. This objection has been entirely overcome in this plant, one element in the solution of the problem being the special clutch coupling employed, which automatically compensates for any residual fluctuations in the speed of the engine, with the result that there is none of the flickering of the lights that has been so common in gas driven plants heretofore. The regulation is equal to that of the best steam driven plants.

The building is wired for 500 lights and the generating plant is capable of operating the full number of lights when required. One unit, however, will take care of the load for all ordinary purposes. The feeders for both light and power circuits are brought to a switchboard of black enameled slate conveniently located in the engine room. These engines operate upon a gas consumption of 17.5 cubic feet of gas per h. p. hour.

The entire generating plant, including engines, dynamos and switchboard, was installed by the Baylis Company, engineers and contractors, New York.

The type of Crocker-Wheeler dynamos employed are rated at 15 kilowatts at 125 volts, and run at a speed of 280 revolutions a minute. They give a free voltage of 115 volts, and are overcompounded 5 per cent. 125 volts are obtained by cutting out all of the field regulator. The dynamos, Fig. 2, have eight poles; the cores of the field magnets being wrought iron, round in shape and cast solid in the circular cast iron yoke. This cast iron yoke has an internal flange on each side, which partly covers the field coils, affording them considerable protection from mechanical injury and at the same time allowing good ventilation. The poles are supplied with removable cast iron shoes, clamped in place by a screw after the field coils have been slipped into position. These shoes reduce the density of the magnet flux in the air gap, and permit thereby a long air gap, which is of great value mechanically. The armatures are of large diameter and short length. The armature winding is done on forms previous to the application to the armature. Each coil is wound, then properly shaped so that it will nest with its neighbor, and then carefully insulated with a layer of oiled muslin and tape. When the winding has been put on the core, it is held down by clamps at each end, and the connections of the coils are made to the commutator tails, which are sufficiently long to keep cool and hold the solder, even if the commutator should, by accident, become overheated. The coils are connected so that there are eight circuits in the armature. The windings of these machines are impervious to moisture and dust; and the manner in which they are applied to the core, permits such ample ventilation that severe overloads can be withstood without destruction of the insulation, although they may raise its temperature above normal. The armature core is mounted on a cast iron spider which has an extended sleeve, upon which the commutator is mounted. The commutators are of large diameter and short length, and have a great many bars. The tails are riveted to the bars, and are made amply long to prevent overheating of solder by the bars.

The method of supporting the brush rods does away with the clumsy cable connections between brushes of the same polarity. Two carrying rings are used, which, while mechanically supporting the brush rods, connect them electrically, the rods being fastened to them. One of these rings holds all the positive, and the other all the negative studs. The rings are insulated from each other, but are mechanically one; and shifting of the brushes is obtained by moving them just as a purely mechanical holder would be moved. The rings, there-

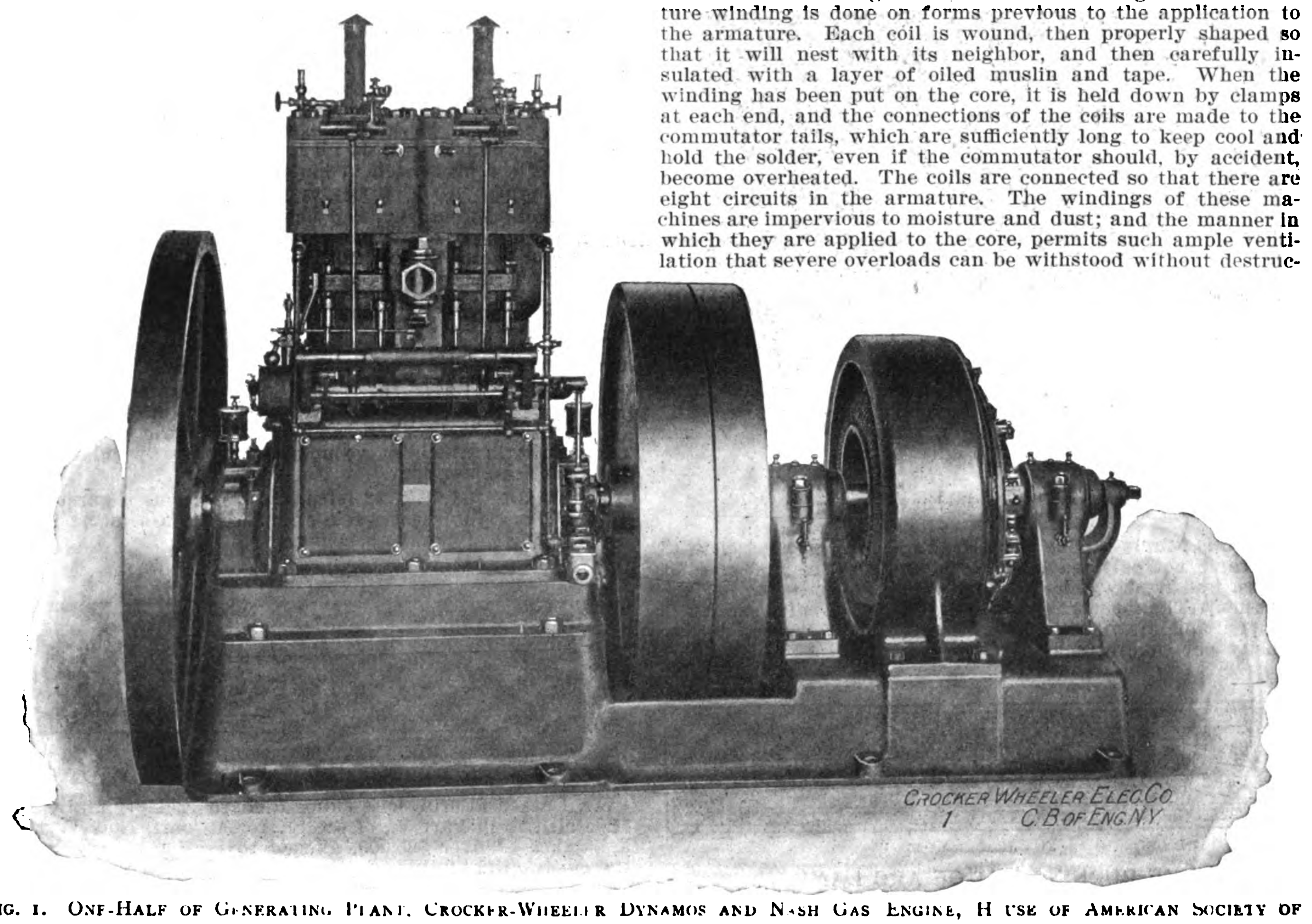


FIG. 1. ONE-HALF OF GENERATING PLANT, CROCKER-WHEELER DYNAMOS AND NASH GAS ENGINE, HOUSE OF AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK CITY.

fore, do away with the insulating of the brush rods and the connecting of alternate studs by cables. On account of the room saved by this arrangement, the carrying rings can be placed next to the armature, permitting the studs to point outward and over the commutator, which enables the brush holder to be withdrawn for cleaning or adjustment while the

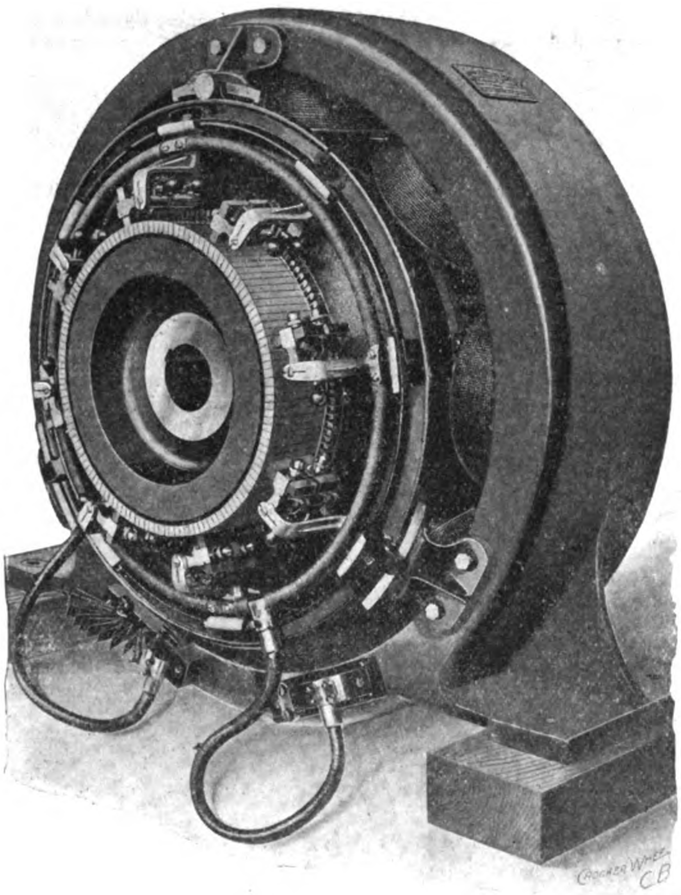


Fig. 2.—Crocker-Wheeler Generator.

dynamo is running. The location of the carrying ring close to the frame not only leaves the commutator free and easy of access, but greatly enhances the pleasing appearance of the dynamo. The brushes are carbon, held in pivotal radial holders, and are of ample size to carry the current at low density per square inch of contact with the commutator.

LETTERS TO THE EDITOR

THE BURNING OUT OF ARC LAMPS.

To what cause, chiefly, is attributable the burning out of the combination and the starting magnets in a T. H. double 2,000 c. p. lamp? We have 23 lamps in the circuit of a 30-light T. H. dynamo.

T. B.

To diagnose the case when the patient is absent is a difficult matter.

From the fact that both magnets are burned it would seem to point to excessive current from some cause, and I would suggest that an ammeter be used to standardize current. Possibly a 1,200 c. p. lamp has by mistake been used on a 2,000 c. p. circuit. See that the starting magnet contacts make good contact; also contact in rocker-arm which controls starting magnet contacts. Notice also whether rods stick or will not descend. There is usually less trouble from burning in the 2,000 than the 1,200 c. p. lamp. Without knowing all the conditions it is impossible to give more than a few suggestions.

H. F. W.

PERSONAL

"CLIMBS IN THE HIGH ALPS."

Under this attractive title, Mr. Garrett P. Serviss will give one of his charming illustrated lectures, in the grand ballroom of the Waldorf-Astoria on Thursday evening, December 2, at 8:15 o'clock. The special features of the new hotel will also be thrown open for view that evening. Admission is $1 and parquet seats are $2. Mr. Serviss is now in the hands of Mr. Harold McGill Davis, well known in electrical circles, and a gentleman whose friends wish him abundant success in the new venture.

MR. FRANK J. WEBSTER, secretary of the Cox Thermo Electric Co., of London, has arrived in New York on his way home. Mr. Webster, who is a brother of Sir Richard Webster, Attorney General of England, has just returned from Venezuela, whither he had accompanied the English Arbitration Commission as legal counsellor.

Mr. GEORGE GALE, Secretary of the Excelsior Electric Company, of New York, was a visitor at the Chicago office of The Electrical Engineer recently.

MR. J. L. MORGAN, who was until recently the electrical inspector for Kansas City, Mo., has by a recent act of the city council had the duties of his office greatly increased and extended. He will now have charge of everything electrical for the city government and becomes City Electrician. To his new post Mr. Morgan brings ability and enthusiasm of a high order, and he will do all he can to promote the best interests of the profession in his field of work.

MR. PETER A. B. WIDENER, president of the Philadelphia Traction Company, and holder of large interests in trolley lines in many cities, intends to give his residence at Broad street and Girard avenue, Philadelphia, which cost $600,000, to the city for a branch of the Philadelphia Free Library.

MR. PONCIANO AGUILAR, director of the Guanajuato, Mexico, Electric Light Company, is spending a few weeks in this city looking up matters electrical in connection with electric light and power work.

MR. HERBERT G. CONDICT has resigned as general manager of the Englewood & Chicago Electric Railway, and accepted the general managership of the Electric Cab Company, of New York, which is, we understand, greatly enlarging the scope of its operations.

MR. E. BERLINER, of telephone fame, was a guest of the Boston Press Club last week, and gave an interesting talk on the principles of sound recording.

LEGAL NOTES

MR. LUTHER STIERINGER SUING FOR ROYALTIES.

Mr. Luther Stieringer is suing Richard N. Dyer and George M. Maitland in Part V., of the Supreme Court, New York, for a balance of over $25,000, alleged to be due on royalties in the electric light fixture appliances invented by him.

Some years ago, Stieringer alleges, he entered into an agreement with Dyer and Maitland under which a company was formed to push his patents.

The profits were to be divided equally among the three members of the company. Stieringer charges that Dyer and Maitland have collected $125,000 in royalties and have paid him but $15,000.

He asks for an accounting and the balance alleged to be due him.

STREET RAILROAD DECISION IN TENNESSEE.

At Knoxville, Tenn., on Nov. 6, the Supreme Court of the State affirmed the decision of the lower court in the consolidated causes, involving rights of way on principal streets for street railroad purposes. The opinion was in favor of the Knoxville Street Railway Company, of which J. Simpson Africa, of Philadelphia, is trustee, and against the Citizens' Railway Company, of which W. G. McAdoo, of New York, is president.

TELEPHONE LITIGATION IN SAN FRANCISCO.

The Western Electric Company has brought suit in the United States Circuit Court, at San Francisco, against the Capital Telephone and Telegraph Company, asking for an injunction and damages on account of alleged infringements of their patented "multiple switchboard." The testimony has been taken and the case is on final hearing.

WESTERN UNION TELEGRAPH COMPANY OBTAINS A HEAVY JUDGMENT AGAINST THE UNITED STATES.

The Chief Justice of the Court of Claims has handed down an opinion confirming the report of Perry S. Heath, referee, in the case of the Western Union Telegraph Company against the United States, and entered judgment in favor of the company for $258,869. The case arose out of a dispute between the government and the company, Mr. Wanamaker, the then Postmaster General making a sweeping reduction in government rates, notwithstanding the telegraph company's protests.

REPORTS OF COMPANIES

PLANS OF THE PACIFIC CABLE COMPANY.

A meeting of the Pacific Cable Company, of New York, was held on November 24 at the offices of the Central and South American Telegraph Company in this city. The following Board of Directors was elected: J. Pierpont Morgan, Edmund L. Bayliss, J. Kennedy Tod, Rear Admiral John Irwin, United States Navy, and James A. Scrymser. Mr. Scrymser was elected president and Edmund L. Bayliss vice-president and acting treasurer. The company announces that the surveys for the cable between the coast of California and the Hawaiian Islands are highly satisfactory, and that arrangements are being made for the establishment of that section within eighteen months. It will require over 9,000 miles of cable to connect the United States with the Hawaiian Islands, Japan, China and Australasia.

The proposed Pacific cable between this country and Hawaii will be up before Congress this session. A bill was introduced in the Fifty-fourth Congress authorizing the Pacific Cable Company, of New York, to lay this cable.

After being reported favorably by the Committee on Commerce in the House it was sent to the Postmaster General for a report. This report has not as yet been given out, but it is said will be presented to Congress soon after it assembles.

Mr. Edmund L. Bayliss, vice-president of the New York Company, has been in Washington looking after the interests of his associates. In an interview last week he said that the government had completed a survey of the route as far as the Hawaiian Islands, and if the bill passed at the coming session the cable would be in running order in 1898.

THE STOCK MARKET

TRADE GOOD AND DOLLAR WHEAT AGAIN.

Business in general may be described as quiet, but in many parts of the country trade is excellent. Wages in several lines have been advanced. Cotton and iron are duller, but other branches report activity. Bank clearings for Thanksgiving week were 21 per cent. better than in 1895, and 31 per cent. better than in 1894, and even exceeded by 4.5 per cent. the boom times of 1891. Failures for the week were 236, as against 296 a year ago, and 298 in 1893. Railroad earnings are steadily good. Wheat has gone above $1 again on the New York market.

On the Stock Exchange, good bonds have been in the briskest demand, and stocks have hardened in spite of the impending session of Congress. The bulk of business is not large, however. For the whole week the sales of Western Union were only 2,236 shares, rising to 87¼. Less than 1,000 shares represented the business in General Electric at about 32. American Bell Telephone hardly moved at slightly lower prices around 260 to 264. New York Edison sold at 125, and Chicago Edison was equally strong at a higher quotation.

In the metal markets copper is quoted at 10¾ to 10⅞ for lake; 10½ electrolytic; casting, 10⅝. Lead is 3.70. Steel rail, girder, is quoted at $23; standard sections, $19 to $20.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOVEMBER 16, 1897.

Alarms and Signals:—

ELECTRIC SIGNALING MECHANISM. L. G. Rowand, Camden, N. J., 593,692. Filed Dec. 23, 1896. Means for automatically repeating a signal on the main line to branch lines.

ELECTRIC ANNUNCIATORS. J. A. Gowans, Stratford, Canada, 593,884. Filed April 3, 1897. Details of construction.

Batteries, Secondary:—

STORAGE BATTERY. E. A. Barber, Watertown, N. Y., 593,559. Filed May 14, 1897. Embodies a stack of trays, each of which has on opposite sides of its bottom portion an integral compartment plate containing the active material.

ELECTRIC BATTERY. W. W. Hanscom and A. Hough, San Francisco, Cal., 593,803. Filed April 21, 1897. The method of constructing elements for storage batteries consisting in mixing litharge and sugar, setting the same by adding sulfate of ammonia, dissolving out part of the sugar and electrolytically reducing to spongy lead.

Conductors, Conduits and Insulators:—

INSULATED HANGER. E. P. Warner, Chicago, Ill., 593,625. Filed March 8, 1897. Adapted for arc lamps. Details of construction.

INSULATOR. L. F. Rembe, Haverstraw, N. Y., 593,689. Filed March 17, 1897. Especially adapted for inside wiring.

METALLIC JUNCTION BOX AND MEANS FOR UNITING CONDUIT TUBES THERETO. E. T. Greenfield, New York, 593,841. Filed July 27, 1897. A metallic junction box having integral screw-threaded necks, in combination with a metal conduit tube and a split nut exteriorly screw-threaded and adapted to hold the conduit tube in the integral neck.

FLEXIBLE ARMORED CONDUIT. E. T. Greenfield, New York, 593,842. Filed Oct. 4, 1897. Consists of a flexible lining and two or more metallic armor strips spirally wound thereon and curved in opposite directions.

Dynamos and Motors:—

ALTERNATING CURRENT MOTOR A. J. Churchward, Brooklyn, N. Y., 593,716. Filed July 1, 1896. Designed to combine in one machine the principle of an alternating current synchronous motor with that of the ordinary direct current motor.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. E. P. Warner, Chicago, Ill., 593,626. Filed March 16, 1897. Feed mechanism.

ELECTRIC ARC LAMP. C. C. Stirling, Hartford, Conn., 593,697. Filed Feb. 6, 1897. Feed mechanism for arc lamps embodying a feeding screw for each carbon.

ELECTRIC ARC LAMP. W. H. Coughlin, Worcester, Mass., 593,738. Filed April 9, 1897. Globe holder for arc lamps.

ELECTRIC ARC LAMP. G. R. Lean, deceased, J. Potter, administrator, Cleveland, O., 593,899. Filed Jan. 23, 1897. Comprises an arc enclosed alternating current arc lamp, using cored carbons, the cores of which are 1-16th of an inch in diameter or less.

Measurement:-

MULTIPLE METERING OF ELECTRIC CURRENTS. E. Oxley, Washington, D. C., 593,852. Filed Oct. 2, 1897. Details of construction.

INDICATOR FOR ELECTRICAL MEASUREMENTS. E. B. Rosa, Middletown, Conn., 593,858. Filed July 13, 1897. Embodies an instantaneous contact maker having a brush adapted to move periodically, a recording surface moving in synchronism with the brush, and means for recording the electrical values on the surface.

Miscellaneous:—

ELECTRICALLY DRIVEN GAS MACHINE. T. J. Fay, Brooklyn, N. Y., 593,718. Filed Feb. 25, 1897. Comprises a gas pump for refrigerating processes within a sealed casing, an electric motor also within a sealed casing and directly connected by its shaft to the pump.

METHOD OF PRESERVING PERISHABLE SUBSTANCES. W. G. Day, Baltimore, Md., 593,741. Filed Sept. 14, 1896. Consists in generating by electrical energy radiant energy and causing it to act upon the perishable substances placed in proximity to the center of action, for a sufficient length of time to destroy all germs of decay.

ELECTRIC BRAKE FOR ELEVATORS. J. P. Casey, Bloomsburg, Pa., 593,832. Filed Aug. 23, 1894. An electrically operated brake which shall positively apply or remove the friction independently of any variations in the flow of current through the motor.

APPARATUS FOR CIRCULATING LIQUID IN TANKS. G. E. Dunton, Boston, Mass., 593,837. Filed Aug. 31, 1897. Consists of a containing tank for the electrolytic bath, having a suction pipe provided at its lower end with an inlet strainer and an outlet pipe leading from the casing of a turbine wheel at the lower end of the suction pipe to the top of the tank on the opposite side to a point below the level of the liquid.

IGNITING DEVICE FOR GAS OR LIKE MOTORS. A. De Dion and G. Bouton, Puteaux, France, 593,877. Filed Sept. 5, 1896. Details of construction.

Railways and Appliances:—

TROLLEY. O. L. Kirsch, West View, Pa., 593,847. Filed April 24, 1897. A trolley having a vertical and a radial movement, as ma-

be required by the relative position of the car and the overhead wire.

STREET AND STATION INDICATOR. S. E. Bisbee, South Pasadena, Cal., 593,956. Filed Aug. 25, 1896. Adapted to be under the control of motorman or conductor, or by mechanism to automatically trip as the car passes a predetermined point.

COUPLING FOR ELECTRIC CIRCUITS IN RAILWAY TRAINS. J. Merryweather, Greencastle, Ind., 593,965. Filed Oct. 7, 1897. Details of construction.

Switches, Cut-Outs, Etc.:—

RHEOSTAT. G. J. Schneider, Detroit, Mich., 593,817. Filed March 5, 1897. Designed to be employed as a motor starter.

ELECTRIC CUT-OUT. H. T. Paiste, Philadelphia, Pa., 593,853. Filed July 8, 1897. The connections between the line wires are exposed so as to be easily accessible and the connections between the cap and base are wholly with the cap.

ELECTRIC SWITCH. W. M. T. Weise, Davenport, Ia., 593,914. Filed Feb. 24, 1897. Intended for use on party telephone lines.

Telephones:—

MULTIPLE SWITCHBOARD SYSTEM FOR TELEPHONE EXCHANGES. C. E. Scribner, Chicago, Ill., 593,611. Filed May 13, 1892. Details of construction.

TOLL COUNTER FOR TELEPHONE LINES. C. E. Scribner, Chicago, Ill., 593,612. Filed Sept. 10, 1894. Located at the exchange and records only complete connections.

POLARIZED SIGNAL BELL. C. E. Scribner, Chicago, Ill., 593,613. Filed Nov. 25, 1895. Adapted for telephone lines, in which the bells are subjected to continuous currents in the line tending to interfere with the ringing of the bell by alternating currents.

TELEPHONE SYSTEM. C. E. Scribner, Chicago, Ill., 593,614. Filed Sept. 25, 1896. Consists in an appliance for closing the circuit of the exciting current during the use of the telephone at a sub-station.

TELEPHONE. J. Weil, Mansfield, O., 593,627. Filed Feb. 25, 1897. Embodies a support for the receiver which will be operated by the weight of the same to actuate the generator connected to the bell circuit.

TELEPHONE TOLL STATIONS. W. Gray, Hartford, Conn., 593,720. Filed Nov. 17, 1893. Operated by falling coins.

TELEPHONE AND SIGNALING OR CALLING SYSTEM. J. G. Smith, New York, 593,819. Filed April 4, 1895. Several stations are located on a circuit and any station can call or signal to any other without calling an intervening station.

ELECTRIC SIGNALING OR CALLING SYSTEM. J. G. Smith, New York, 593,820. Filed April 4, 1895. Similar to above.

TELEPHONE TOLL APPARATUS. W. Gray, Hartford, Conn., 593,962. Filed Feb. 8, 1897. Embodies a metallic channel plate supporting a signal device, a metallic post supporting a transmitter and a metallic connection uniting the transmitter post and the channel plate.

THE NEW TYPE OF X-RAY APPARATUS.

WE are in receipt of a very entertaining and artistic little booklet entitled "Concerning X-Ray Apparatus," and issued by Mr. James G. Biddle, 910 Drexel Building, Philadelphia. This pamphlet is published in the interest of the Willyoung X-ray machines and the new "Jagabi" self-adjusting X-ray tube for which Mr. Biddle is sole selling agent. It is profusely illustrated with half tones and printed in large type on heavy paper, with wide margins. Among the illustrations are a number of radiographs made with the apparatus, as also diagrams showing the plan of the various types of apparatus used. Other illustrations are of the apparatus itself, tubes and accessory pieces.

Among the interesting sub-headings of this booklet are the following: "Prof. Roentgen's Discovery;" "The Sources of Electrical Supply;" "Induction Coil or Tesla Coil?;" "To Produce the X-rays by the Use of the Static Machine;" "Fluorescence and the Fluoroscope;" "Practical Uses of the X-Ray;" "X-Rays and Dermatitis;" "How to Procure the Right Outfit;" "'Jagabi' Adjustable Vacuum Tubes;" "Stands for X-Ray Tubes," etc. Each of these topics is simply and thoroughly treated in a way that should be very intelligible and helpful to intending purchasers.

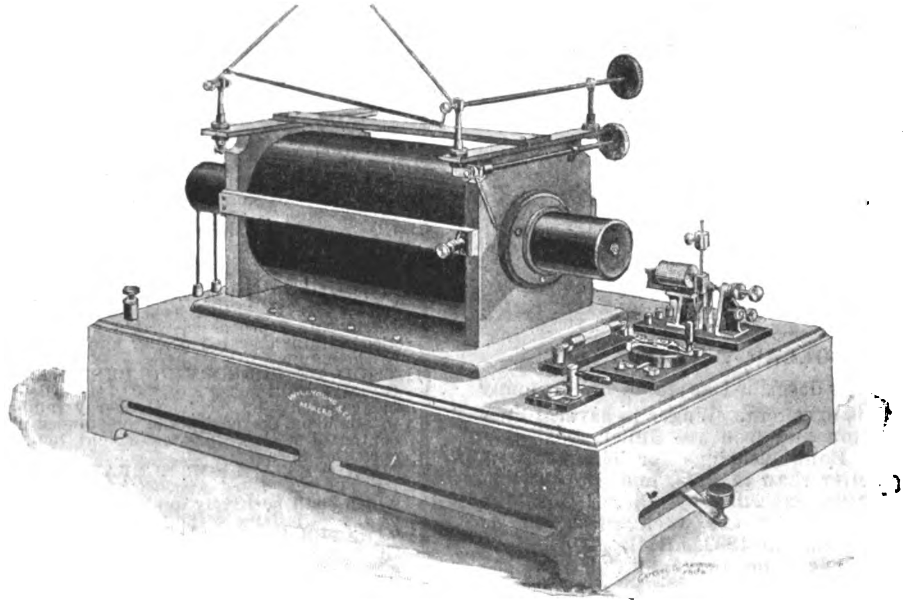
In all of the new X-ray apparatus the vibrator used is of the independent Willyoung type. The current in the coil proper may thus be varied through any range without in any way affecting the character of the break. To change the rate of break, requires merely the adjustment of a small bob.

In addition to the usual spark gap in parallel with the tube, all the type Willyoung apparatus is equipped with a "series" gap as well; this latter gap is in series with the tube, and not only gives a fine regulation of the amount of energy expended in the tube, but also serves to damp out the discharge at make, which if allowed to take place, would blacken and eventually destroy the tube. Both these spark gaps are adjustable by use of milled heads conveniently located.

For the protection of the apparatus each one is equipped with an improved form of interlocking switch; this switch controls two circuits, that of the vibrator (or break) and that of the coil, in such a way that the coil circuit can only be closed after the vibrator circuit is closed and must always be opened before. In this way the coil can never be short-circuited or burned out. A safety fuse prevents similar danger of "burn out" from excess of current. In operating the interlocking switch, pulling the handle forward closes the vibrator circuit, it can then be moved to right or left so as to close the coil circuit in the one direction or the other. To open the circuit these operations must be reversed.

The Willyoung apparatus is made for either battery or 110 volt circuits. It is also made in a variety of styles, according as it is to be used in office, out door, or hospital practice.

For hospital work the Willyoung apparatus is especially recommended by the manufacturers. In this form the coil proper is concealed permanently within the cabinet, nothing appearing on top except the various manipulative devices, spark points, condenser switch, vibrator, fuse, etc., All of these parts are handsomely finished and present a rich appearance in contrast with the cabinet, which is of polished cherry. When not in use, a beveled plate glass top encloses these parts. At the left is a swinging leaf, while the tube stand is attached directly to the cabinet, having universal motion by means of a special clamp. A cupboard below gives ample room for a fluoroscope and odds and ends, while two drawers give space for tubes. When battery power is used, the battery is placed



"1898" Type Willyoung X Ray Machine for 110-Volt Circuits.

in a space to the rear of the cupboard (not to be seen in the engraving). The whole cabinet is mounted upon three-inch castors with heavy rubber tires, and may thus be quickly and noiselessly pushed about from room to room or through a hospital ward right up to the bedside of a patient.

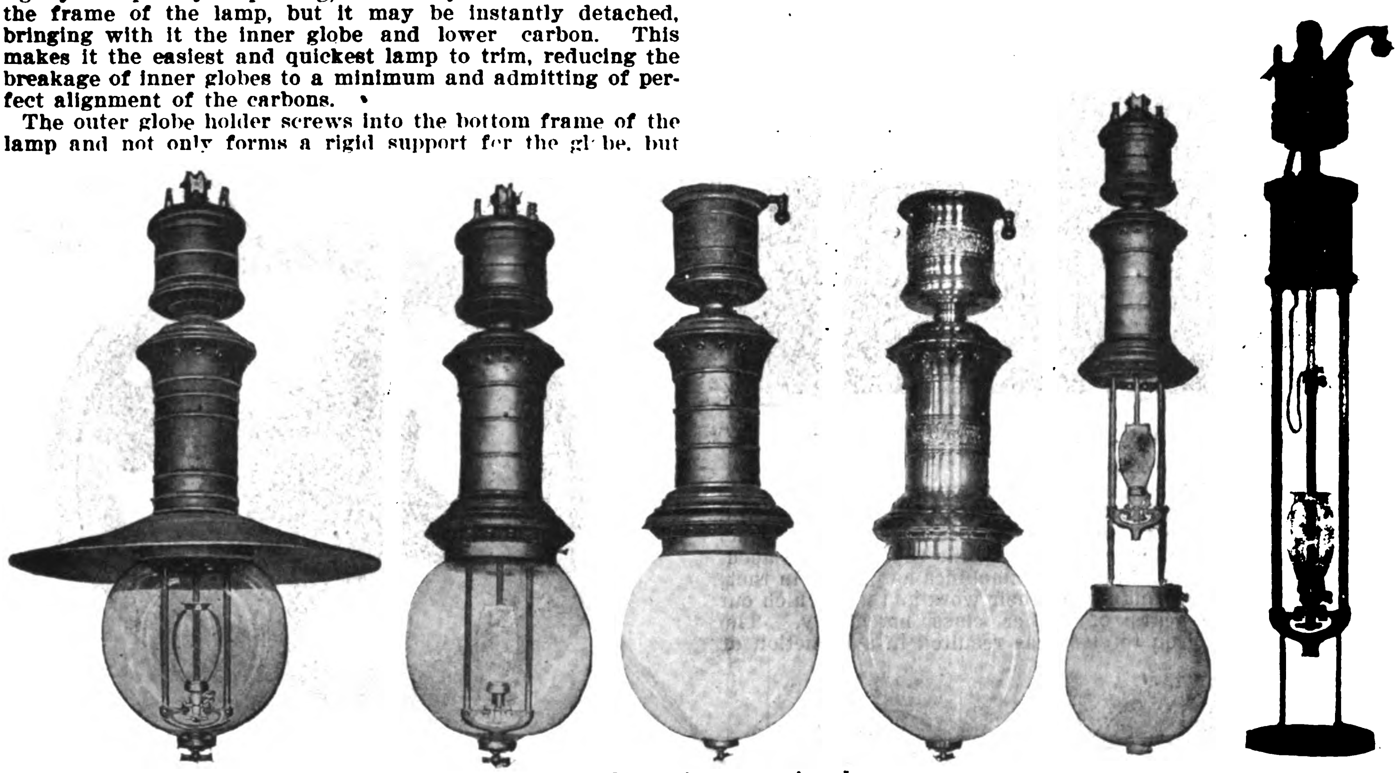
TRADE NOTES & NOVELTIES

DIEHL ENCLOSED ARC LAMP.

THE use of enclosed arc, or long burning, lamps in modern electric lighting practice has become so general and the advantages of this class of lamps are so thoroughly understood that no mention of their merits is here necessary, the object of this article being a description of the latest type of this lamp to be placed on the market by the Diehl Manufacturing Co., of Elizabethport, N. J.

The illustrations show the general design of the lamp for indoor and outdoor use, and the method of lowering the outer globe and holding it in position while the lamp is being trimmed. The lower carbon holder, to which the inner globe is rigidly clamped by a spinning, is securely held in a socket on the frame of the lamp, but it may be instantly detached, bringing with it the inner globe and lower carbon. This makes it the easiest and quickest lamp to trim, reducing the breakage of inner globes to a minimum and admitting of perfect alignment of the carbons.

The outer globe holder screws into the bottom frame of the lamp and not only forms a rigid support for the globe, but



THE NEW DIEHL ENCLOSED ARC LAMP.

permits standing the lamp on end during installation or at any time when it may be necessary to take it down.

The cut of the mechanism shows its extreme simplicity. There are no gear wheels, pinions or springs. The magnets are firmly held at both ends and two large dash-pots maintain a steady arc without flickering or jumping. The clutch is a particularly firm yet sensitive one and gives to the lamp an almost imperceptible feed. There are no sliding contacts on the rack rod, the current being supplied to the upper carbon by a flexible cable.

It is impossible for a carbon to become jammed in the lower holder, as it is so designed that by loosening one binding screw the jaws may be entirely removed from the holder. This joint will be found of the greatest convenience.

In case of breakage of an inner globe or bulb, a new globe may be inserted in the spinning already on the lamp, as the bulb is retained in the spinning by a binding coil. This obviates the purchase of a new spinning with every globe and when screwed down upon the lower carbon holder it forms an absolutely air-tight joint.

The ornamental lamps are furnished in a number of special finishes, the ones most in demand being bronze, ebony, iridescent, oxidized copper, oxidized brass, dull brass with black bands, antique copper and gold lacquer, the latter giving an especially rich effect.

The plain indoor lamps are furnished in lustrous black, but may be had in a dull black finish instead, if so desired. All indoor lamps, whether ornamental or plain, are equipped with switch for turning the current on and off.

ALMY WATER TUBE BOILER CO'S CATALOGUE.

THE most recent catalogue issued by the Almy Water-Tube Boiler Co., Providence, R. I., and now in its sixth edition, cannot fail to please the seeker for information. It is well illustrated and printed, but its marked feature is its conciseness. Under such headings as Material, Design of Single Tube Boiler, Casing, Heating Surface, etc., each characteristic is thoroughly but briefly described and all details as to dimensions are tabulated. There are no testimonials published, but in their place is a list of all who have installed Almy boilers and the prospective buyer is referred to the user. The list is a long one and includes some seventy yachts and twenty-five passenger steamers.

The last few pages record an evaporative test made by Geo. H. Barrus, of Boston, Mass. It appears from these results that, in point of economy, the boiler compares favorably with the best types. An evaporation of 11.922 pounds of water per pound of combustible, which was obtained on the test of November 2, is rarely exceeded by any form of hand-fired water-tube boiler, whatever its size. One of the noticeable features in the operation of the boiler was the dryness of the steam exhibited on all the tests. Even with conditions of forced blast, when over seven pounds of water was evaporated per square foot of surface per hour, the moisture was less than 1 per cent.

THE DEANE PUMPING MACHINERY.

THE Deane Steam Pump Co., of Holyoke, Mass., may well be congratulated on their handsome new catalogue of steam and power pumps and pumping machinery. It is 5 by 8 inches in size, printed on heavy calendered paper, contains 136 pages elaborately illustrated with half-tone engravings, and is bound with flexible covers stamped in gold. In it may be found detailed information regarding their single, duplex and triplex pumps, which in one form or another are adapted to more than 70 different general uses. They range in size from the single No. 0, with a capacity of .01 gallon per stroke, to their triple expansion condensing duplex high duty pumping engine, capable of discharging over 6,000,000 gallons each 24 hours. All dimensions, capacities, etc., have been tabulated. The book also contains directions for setting up and operating pumps and other useful information pertaining to hy-

draulics. This data has been carefully collected and its arrangement is admirable. It cannot fail to make the book valuable to the engineer. A telegraphic code has also been added, leaving, it would seem, nothing to be desired.

A MODERN GEAR PLANT.

A LOW estimate places the number of electric railway motor gears in daily use in the United States alone at 50,000 at least, and as the average life of the gear is about two years, a yearly output of from 20,000 to 30,000 is necessary for renewals alone, exclusive of those required for new motors.

In the pioneer days of the electric street railway, the cast

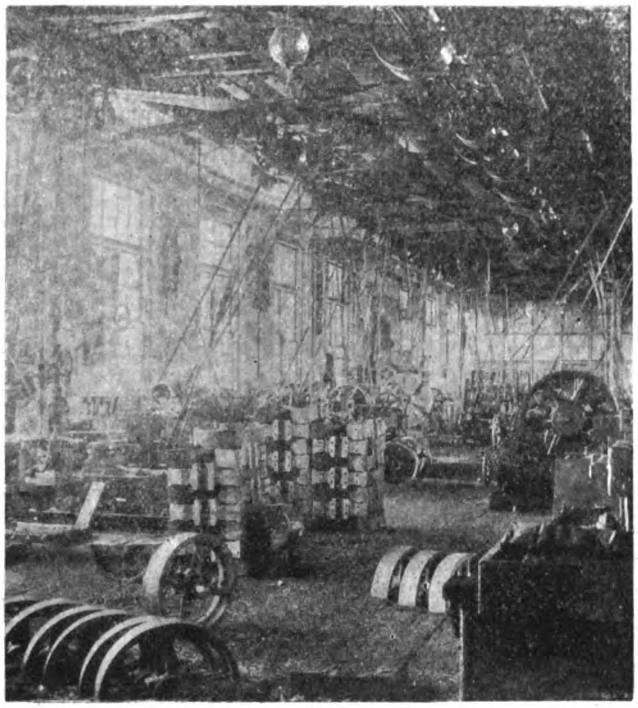


Fig. 1.—View in G. E. Gear Shop, Lynn, Mass. [redacted]

iron gear and pinion of gun metal were used exclusively. Experience and time necessarily brought about improvements and changes. To-day the standard motor gears are of cast steel and the pinions of hammered steel, while the teeth are accurately cut from the solid stock by machines as perfect in their adjustment and performance for their work as those which cut the more delicate gears of higher class machinery. The change from cast iron to steel has resulted in a reduction of

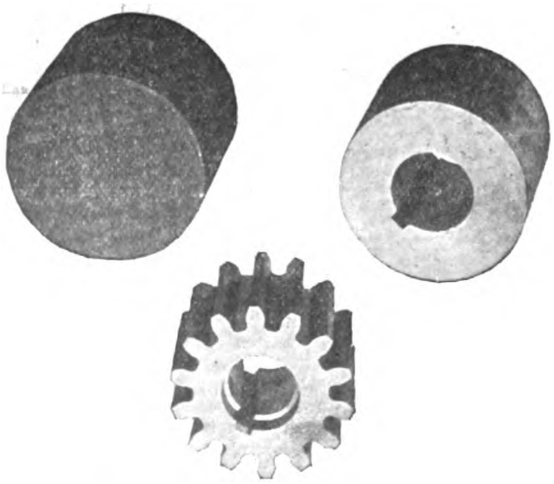


Fig. 2.—The Growth of a Gear.

some 60 to 70 pounds in the weight of the gears, while their life has been very materially increased. A steel gear will wear more than twice as long as a cast iron gear, and while with the latter type breakage was a common occurrence, with the steel gear breakage is practically unknown.

To supply gears which would carry in themselves a guarantee of perfection, the General Electric Company, established some time ago, at its River Works, Lynn, Mass., a plant for the manufacture of gears and pinions. This plant is a model of its kind. The cutting machinery is of the most modern character, and the entire plant is laid out on a comprehensive scale. In this building is an extensive foundry for the gear blanks, as well as the gear cutting shop. The former is equipped with overhead traveling cranes, driven by electric motors, furnaces for the molten metal, core ovens, and modern appliances of all kinds for the manufacture of steel castings of the highest grade. The great difficulty encountered in making steel castings, the tendency to secure blow holes, draws and cracks, has been overcome in this foundry. After a long series of experiments, the General Electric Company perfected a process which now enables the foundry man to produce steel castings which are as practically perfect as if of hammered steel.

Fig. 1 is a view of some of the special drill presses, milling machines, etc., with a lot of gears in course of preparation for the teeth cutting machines.

The process of manufacture of a pinion is illustrated in Fig. 2, showing the pinion forging, the pinion blank, milled, bored and seated, ready for the teeth to be cut, and the finished pinion ready to ship. Fig. 3 shows a steel gear, bolted together and machined, with part of the teeth cut. These teeth are cut from the solid stock by specially made cutters, themselves designed after exhaustive experiments. The machines used are both elaborate and expensive and are of unusually heavy design and accurate workmanship. They are all fitted with ingenious devices for producing uniform teeth. The pinions are cut from the best hammered steel forgings, and the teeth are cut with the same care as is taken in the cutting of the gears. All, that is, both pinions and gears, undergo a rigid inspection before shipment.

The question of age of gears has not, perhaps, received from street railway managers the attention it deserves. In the life of gears there is a distinct difference between the extreme life

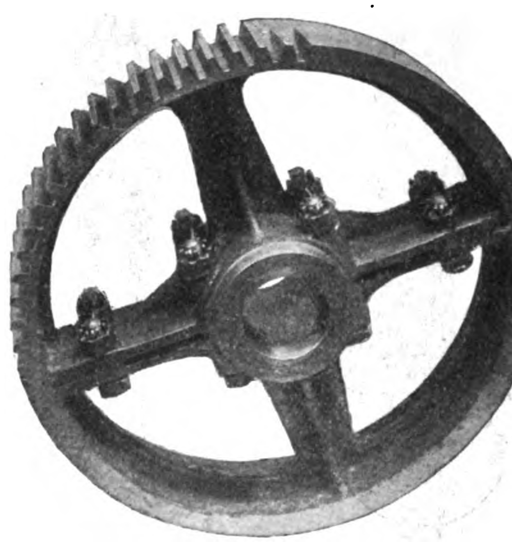


Fig. 3.—A Gear Under Way.

and the proper economical life. There is a point in the age of gear and pinion at which it becomes more economical to consign them to the scrap heap and to use a new gear and pinion than to retain them in service. The question is a nice one and a series of efficiency tests have recently been carried out. While the results are not yet collated, it may be said that a worn gear and pinion require some 400 watts more energy than a new gear and pinion. This is a statement made authoritatively, and one which will give food for profitable thought to managers of electric railways.

GENERAL INCANDESCENT ARC LIGHT CO.

In an interview with Mr. F. E. Dolbier, manager of the arc lamp sales department of the General Incandescent Arc Light Co., he stated that the continued and increased success which they are meeting in the sale of their enclosed arc lamp denotes the popularity of their product, and the satisfactory service obtained by the use of the same. He mentioned among others, that they had just closed a contract for the installation, with their Bergmann enclosed arc lamp, in the new addition of Bloomingdale Bros.' dry goods store in New York City.

IMPROVEMENT IN PACKARD LAMPS.

An improvement in the manufacture of Packard lamps has recently been perfected which makes this leading specialty a practically smokeless lamp. The improvement produces a lamp which is practically undimmed to the end of its life. There is said to be absolutely no perceptible blackening of the globe even during a life of 800 to 1,000 hours. The improved process is being rapidly applied to all of the lamps made by the Packard Company and their entire product will soon be made up of smokeless lamps.

The Electric Appliance Company, the general Western agents for the Packard lamp, have been making some interesting tests along this line, and report that the new lamp is a wonder. The trade will soon have an opportunity to determine for themselves the merits of the smokeless lamp by comparative tests of their own. It is believed that the results will be very largely to the benefit of the Packard lamp and the Electric Appliance Company are looking for a very largely increased business in that specialty.

WESTERN ELECTRIC CO.'S HAPPENINGS.

The Western Electric Co. are placing upon the market an ornamental enclosed arc lamp similar in style to their standard enclosed arc lamp, but finished in polished brass. The features of this enclosed arc lamp have placed it in the front rank.

The name "Economy," which the Western Electric Co. have adopted for their specially prepared carbon battery, has become well known among the contractors owing to the efficiency of the battery.

The Western Electric non-sparking brush, which is manufactured by the Western Electric Company, is made under Letters Patent No. 419,660, granted to Ludwig Gutmann, and is composed of a composition of high and low resistance metals.

The Occident Club gave a very entertaining musicale in their rooms in the Western Electric Company's building recently.

Although the speaking tube is not an electrical article, it is closely associated with the electrical business, and the Western Electric Company, one of the largest manufacturers of material for household use, are also one of the largest manufacturers of speaking tube in the world. On the quality of their tube they expend considerable pains.

ADVERTISERS' HINTS

THE MANHATTAN GENERAL CONSTRUCTION CO., 11 Broadway, New York, are introducing a photo-engraving lamp for direct currents of 110 to 220 volts. They claim it to be noiseless, steady, without shadows, substantial and to burn at any angle. They also manufacture an automatic focusing theatre lamp.

THE WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg, Pa., remind the public of the Wurts lightning arresters and also of their arc lamps, motors, meters, switches and circuit breakers.

THE BOILER EXPURGATOR CO., Chicago, Ill., have appointed Bibber-White Co., 49 Federal street, Boston, as the eastern distributors of Holm's Tesoline commutator compound.

THE NEW YORK TELEPHONE CO.'S stations in this city have now reached 24,000. A prodigious number.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, say the Packard incandescent lamps have been giving the best light for the last nine years and have lost none of their good points.

THE WESTINGHOUSE MACHINE CO., Pittsburg, Pa., advertise the Roney mechanical stoker and set forth the advantages its ten years' use under trying conditions so clearly demonstrate.

THE ANCHOR ELECTRIC CO., 71 Federal street, Boston, have something to say about farmers and switches—more especially the latter, and the tests their materials have to undergo in selection.

THE BULLOCK ELECTRIC MFG. CO., Cincinnati, O., illustrate their latest direct connected generator. It is described in detail on another page.

THE STANDARD AIR-BRAKE CO., 100 Broadway, New York, say that while their air-brake system has been in use in this and foreign countries for more than five years, there has not been a single accident involving injury to person or fatality.

THE ELECTRICAL EXHIBITION CO., 15 Cortlandt street, New York, say that space is being rapidly taken for the big show in Madison Square Garden and that interested parties will do well to act with as little delay as possible in securing it.

W. H. BOWDLEAR & CO., 149 Pearl street, Boston, advertise insulating compound—black, brilliant and elastic—as well as waxes of all kinds.

THE WHEELER REFLECTOR CO., Boston, Mass., may be addressed for their catalogues of over 200 styles of reflectors. It shows reduced price lists.

ADAMS-BAGNALL ELECTRIC CO., Cleveland, Ohio, manufacture arc lamps for all circuits. They illustrate their series enclosed.

THE DIEHL MFG. CO., Elizabethport, N. J., advertise their enclosed arc lamps, of which a fuller description may be found elsewhere in this issue.

WM. T. PRINGLE & CO., 1026 Filbert street, Philadelphia, Pa., are advertising a very neat receptacle and attachment plug, on which they will be glad to quote prices.

THE HELIOS ELECTRIC CO., Philadelphia, have a 2½-ampere, 220-volt arc lamp for power circuits having excessive and frequent fluctuation.

THE WALKER COMPANY illustrate a controller and mention some of its special features.

WM. ALPHEN, Gloucester, Mass., advertises Alphen's improved belt dressing for preserving belts and keeping them from slipping and will send samples free on application.

NEW YORK NOTES.

NATIONAL WATER-TUBE BOILER CO., New Brunswick, N. J., have issued a neat pamphlet of testimonials regarding their boilers and rocking grate bars, from electric light and street railway companies, mills and other users. The book is illustrated with details of their apparatus and with pictures of some of the plants where the National output is to be found.

MR. A. O. SCHOONMAKER, 158 William street, New York, has just published a broad sheet of testimonials as to the quality of his solid sheet mica segments, built up and gauged to thickness. The letters are from various companies and firms using the material, some of them for years past.

ST. PATRICK'S CATHEDRAL.—Mr. Cornelius O'Reilly, chairman of committee, informs us that the Board of Trustees of the Cathedral are desirous of receiving proposals with plans, specifications, etc., to ring electrically the nineteen bells recently placed in the steeples. Any of our readers are invited, if they have such plans, to submit them at once. Mr. O'Reilly's address is 109-123 East 44th street, New York City.

NEWARK, N. J.—The installation of the People's Light and Power Co., of Newark, N. J., will shortly be increased by 18 125-light Brush arc dynamos, having a total capacity of 2,250 arc lamps, of 2,000 c. p.

RAPID TRANSIT.—The New York Supreme Court Commission has reported in favor of the proposed Elm street underground electric road at a cost of about $33,000,000. They regard it as a paying investment, which it would be likely to be if operated in private hands instead of as a political job.

NEW ENGLAND NOTES

THE CONNECTICUT PIPE MANUFACTURING CO., of New Haven, Conn., are at present busily engaged in completing their large contract with the King's County Electric Light Co., of Brooklyn, before cold weather sets in. Their contract calls for over 500,000 feet of duct, which will be laid in about fifteen miles of street. Mr. E. H. Phipps is taking charge of the work himself, and as the whole contract has to be completed in two months' time, he is bending every energy to have the work done in an exceptionally short period. There are something like 700 men employed on the job, and the work of paying off weekly, on the street, is an interesting sight, and one involving much labor and not a little risk. The ditch work has not proved as easy as expected, many unforeseen obstacles having been encountered, and blasting has had to be frequently resorted to. Mr. Phipps is making his temporary headquarters at 168 Montague street, Brooklyn, and will be glad to receive a call from his numerous friends, who will find him extremely busy, but always ready to give up a few minutes for other purposes.

THE AMERICAN ELECTRIC HEATING CORPORATION will remove its general offices from the Sears building to its

factory in Cambridge, Mass. The company is reported doing a good business. A scaling of the capital stock from $10,000,000 to perhaps $1,000,000 by reorganization is said to be a possibility of the future. The company has $300,000 bonds outstanding of a $1,000,000 issue. They begin to draw interest in January.

WHEELER REFLECTOR CO., Boston, are busy filling many orders, a notable one of recent date being a shipment of about 4,000 reflectors and shades to South America. They are particularly busy on specialties for show window and street lighting, also headlights for electric street railways. They are always pleased to mail any of their special catalogues on application.

ANCHOR ELECTRIC CO., 71 Federal street, Boston, have for a month past, owing to the large number of orders received, put on a night shift of workmen at their factory and running same regularly up till 12 o'clock at night. They report a very satisfactory business, especially on their switches.

WESTERN NOTES

SAN FRANCISCO, CAL.—The Electro-Motto Sign Company has been incorporated by Joseph E. Shearer, John L. Cahill, Jason W. Nash, George L. Cahill and G. W. Robertson, with a capital of $500,000, of which $500 has been subscribed.

THE B. F. CHASE CO., the well known sign makers, were the fortunate contractors who secured all the illuminated sign work for the famous Horse Show held in Chicago. They used exclusively the Sunbeam incandescent lamp, a number of them being the special 4 c. p. lamps designed especially for sign work. The Western Electric Company is agent for this lamp.

STANDARD TELEPHONE AND ELEC. CO., of Madison, Wis., have recently issued an excellent illustrated catalogue, in handsome gold and green grain cover, devoted to their well-known apparatus for central exchange and private line use. The Mildé carbon telephone is their specialty and is in successful operation in a large number of places in connection with their boards, etc. They make also a fine line of details, such as lightning arresters, magneto-generators, batteries, etc. The pamphlet is accompanied by a number of strong testimonials for users of the apparatus.

OMAHA, NEB.—A notable change is about to be made at Omaha, Neb., where the new local Thomson-Houston Electric Light Company is undertaking the concentration of its station. It has recently placed an order with the General Electric Co. for three monocyclic alternators, each one to be directly connected to a compound condensing McIntosh & Seymour engine. These alternators will be revolving armature, 48-pole machines, each of 300 k. w., at 150 revolutions, and will be separately excited. They will take the place of a considerable number of smaller machines and will be used to furnish current to an extensive system of 3-wire secondary mains fed from large transformers.

SOUTHERN NOTES

NEWPORT NEWS SHIPBUILDING AND DRY DOCK CO., of Newport News, Va., are erecting at their shipyard a crane capable of lifting 140 tons. This crane is to be used for the placing of engines, boilers and other machinery in the large war vessels which they are constructing for the government, and will be also used for placing on the sides of these vessels their armor plates, some single pieces of which weigh from 40 to 50 tons. The crane will have sufficient reach so that it will cover the entire width of a large cruiser. This crane revolves in a circle on a turntable which is supported on a steel foundation about twenty-five feet high. This steel foundation is to carry, besides its own weight, the weight of the crane, its machinery and whatever load may be lifted, which altogether will aggregate 900 tons. The steel support for this crane is being furnished and erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

NORTHERN ELECTRIC CO., of Baltimore, has now issued an announcement as to its purchase of the local United States Electric Power and Lighting Co. and as to its increase of facilities, etc. The board of directors is a strong one, including John M. Denison, president; Chas. Marshall, vice-president; J. Frank Morrison, general manager; C. M. Armstrong, treasurer, and F. M. Colston. Mr. Morrison is universally known throughout the electric lighting industry in America, especially as the first president of the National Electric Light Association.

PHILADELPHIA NOTES

ELECTRIC STORAGE.—There remains a full month and over in the current fiscal year of the Electric Storage Battery Company. To date gross business is between $800,000 and $900,000, against $646,318 for the complete year 1896. It is believed the million mark may be reached, and if it is the net receipts will be between $300,000 and $400,000, as against $135,062 last year. The business is being well handled.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXIV. DECEMBER 9, 1897. No. 501.

WATER POWER AND ELECTRIC PLANT AT THE ADDA RAPIDS, NEAR PADERNO, ITALY.

THE River Adda has its origin on the Alps of Valtellina and is the main affluent of Lake Como. It enters at the north end of the lake, which has the shape of a Y with the two legs pointing south, and constitutes the only outlet of the lake, which has a surface of 150 square kilometers. At Lecco, on the extreme end of the eastern leg of the lake the Adda again takes its course with a larger body of water and flows through and irrigates a most picturesque and productive section of Italian country until it meets the River Po near Cremona. At 22 kilometers south of Lecco the Adda forms its Rapids near Paderno. This point is in a straight line about 20 miles from Milan, 11 from Monza and from 10 to 12 miles from Bergamo, Treviglio and other smaller towns which are in the most industrious section of Italy.

The idea of utilizing for neighboring industries the water power of the Adda Rapids dates far back and many studies have been made to this end by Italian and foreign engineers, but not until the transmission of power had been made feasible by electricity did these studies come to a solution. In 1889 the Italian engineer Enrico Carli applied to the Italian government for a concession to draw from the River Adda at the Paderno Rapids, on the left side of the river a volume of water of 30 cubic meters per second, utilizing 65 feet fall.

Before the concession had been issued, the Italian Edison Company of Milan acquired from Carli all the rights to the concession which was made over directly to that company. Subsequently in 1892 the same Carli, after elaborate studies of the problem, presented to the Edison Company a completely new solution with drawings and details of the works to be done which were substantially different from the first concession. At the north of the rapids there existed a dam which was, and now is, used for deriving water for a canal and a system of locks on the right side of the river through which the canal boats are raised or lowered between the two water levels at the two extremes of the rapids.

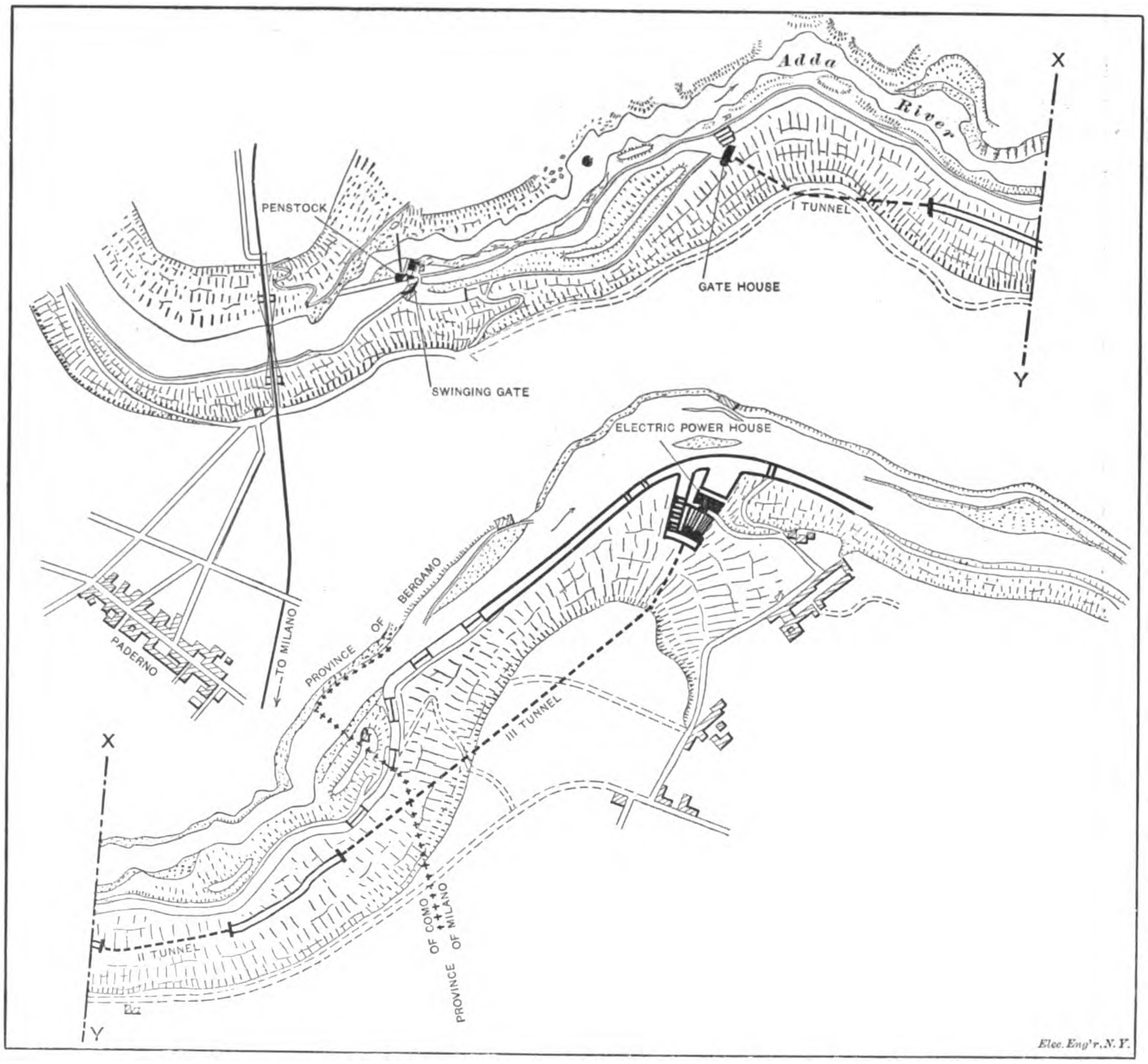


FIG. 1.—MAP SHOWING PLANS FOR UTILIZING THE ADDA RIVER RAPIDS, NEAR PADERNO, ITALY.

The fear of making worse the already poor condition of navigation at this point had dissuaded him from the idea of deriving the water at, or north of, this dam, but the more recent investigations persuaded Carli that his fears were unfounded and that a better regulation of the canal would be obtained by deriving the water at the very point of the existing inlet to the canal, on the right side of the river. The newly projected works gave also a larger amount of power, utilizing 26.50 meters fall instead of 16.70 meters, giving 10,960 theoretical horse power.

The Edison Company obtained a new concession on this

basis and in 1895 started the construction work. In the meantime the unfortunate Carli having become insane, the Edison Company entrusted the work of revision and construction of the hydraulic plant to the engineer Paolo Milani, who since 1889 had assisted Carli in his work. Milani has introduced many and substantial modifications to the original plans, one of which increases the volume of water derived from 30 to 45 cubic meters per second, which step he found advisable to take after a new and accurate determination of the minimum flow of the river during an exceptional period of low water in 1895—96, which gave 35½ cubic meters per second.

The main construction data for the canal are: Water flow at very low water, 45 cubic meters per second with 28.80 meters fall; water flow at maximum high water, 52.25 cubic meters per second with 24.80 meters fall; constant power developed in both cases, 17,280 theoretical h. p. or 12,960 mechanical h. p. with 75 per cent. efficiency of turbines.

The final plan of the works as constructed is shown in bottoms at 10 feet 10 inches, and one at 9 feet 9 inches below the normal water level in the intake basin; the third one feeds a pipe operating the electrical plant installed near the dam during the construction work. Each section of the penstock has a wooden gate operated by a winch. At the two sides of each penstock, north and south, there are recesses for placing suitable planks to make a water tight box around the gates, making feasible any repairs to them. At the right of the penstock there is a two-story house for the watchman, providing also room for storing tools, implements, etc.

The existing navigation canal has been utilized for a good portion of its length for the combined use of navigation and power. To provide the extra section needed for a flow of 45 cubic meters per second the canal has been widened from about 34 feet to an even width of 40 feet, keeping the same depth. The bed and walls of the canal are lined with cement.

In place of the old wooden gate at the inlet of the canal there have been placed two swinging gates originally designed by

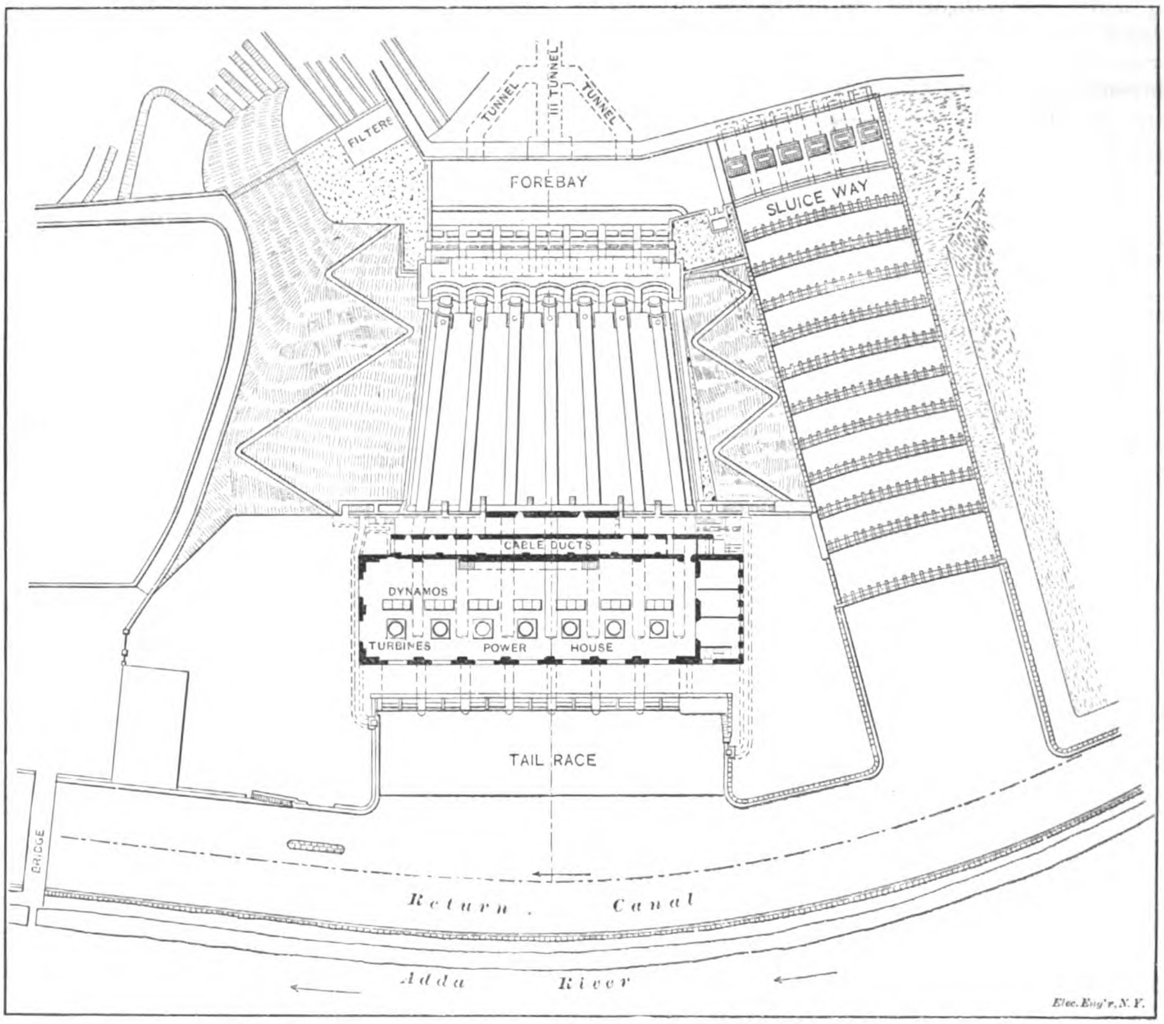


FIG. 2.—PLAN OF POWER HOUSE AND HYDRAULIC WORK, PADERNO POWER TRANSMISSION, ITALY.

Fig. 1. The intake basin is located at the point of the existing inlet to the navigating canal and the normal water level in this basin has been kept coincident with the limit of water level admissible for navigation. The existing dam has been leveled down an average of 16 inches and prolonged 80 feet, making a total of 520 feet. On top of the dam has been built a movable dam of the Poiree type made of iron braced frames at 8 feet 3 inches from each other made of maple wood, 3¼ x 4 inch timbers, slightly inclined towards the stream line. These timbers are all kept in place during the maximum low water period, all taken away when the level of the river is at, or above, the normal level in the intake basin, and partially in place at intermediate heights of water. At the right end of the dam there is a penstock for the double purpose of facilitating the regulation of the height of the water in the intake basin in combination with the movable dam during the period of flood and at low water, and also for the discharge of sediment in front of the inlet to the canal. The penstock consists of three sections of 6 feet 8 inches width each, two with their

Carli and retained by Milani. Each gate, Fig. 5, is made of a strong vertical shaft around which can rotate four rows of iron arms disposed on a sector of a circle, all solidly connected between one other, which constitutes the resistent frame of the gate. On the crown of the sector is riveted a cylindrical apron of iron whose surface has a radius of 20 feet 6 inches, the total height of the gate being 15 feet.

Under the bottom of the gate there are bronze rollers running on rails upon which the gate is revolved. On the upper convex surface of these gates there is a toothed sector operated by a worm gear by which the gate is moved. These gates are more or less closed to block the inlet to the canal at the time that the level of the river exceeds the maximum limit for navigation in the canal; at all other times they will be kept open and enclosed in their stone niches on the two sides of the canal.

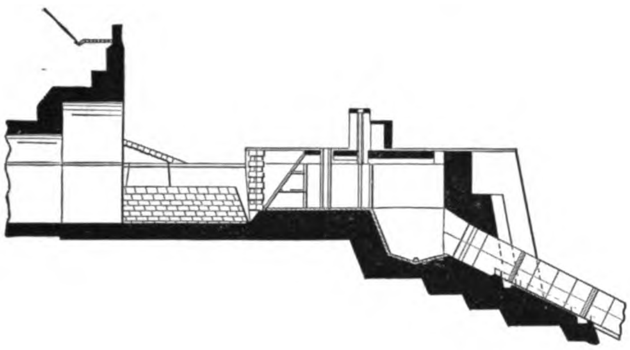
Along the first portion of canal there are three lateral penstocks, the first two with two sections, the third with three. Each section is of 6 feet 7 inches width and like the previously

described penstocks these also have wooden gates arranged in the same manner.

The grade of the canal is of 0.002. This first portion of canal is 2,300 feet long; at its end a basin is formed from which the water for the navigation canal takes its old course and the water for power purposes is admitted to the power canal. In this vicinity there is a sluice way of ten sections of 6 feet 6 inches each at the height of the normal level of water. From this point the new canal begins, as shown in Fig. 2. A gate house for the inlet has been built which divides the flow of water into six streams, each passing through channels provided with an iron gate. These are operated from the bridge room built across the canal. Immediately below the gate house the canal enters a tunnel 1,330 feet long, then runs on an embankment at the end of which it enters a second tunnel, 276 meters long; then comes a length of 825 feet, on an embankment, and lastly a tunnel of 3,300 feet. The constant grade is of 0.90 per thousand. The last tunnel enters the forebay, shown in Fig. 2, which is divided into three branches arranged like the tines of a fork, and each branch is considerably increased in section in the last 13 feet in order to diminish the velocity of water arriving at the forebay to 3 feet 3 inches per second.

Figs. 2 and 3 show the disposition of the pipes carrying the water from the forebay to the turbines. The pipes are made of steel with funnel-shaped inlets and have a diameter of 7 feet.

An important and original construction is found in the sluice way at the right of the forebay. There are six discharging outlets in the supporting wall and six other outlets on the axis of the basin built with opposite wells, as shown in section in Fig. 3. To minimize as much as possible the production of spray in the vicinity of the electrical plant the water in the sluice way falls from one step to another through L-shaped conduits, as shown in Fig. 4.



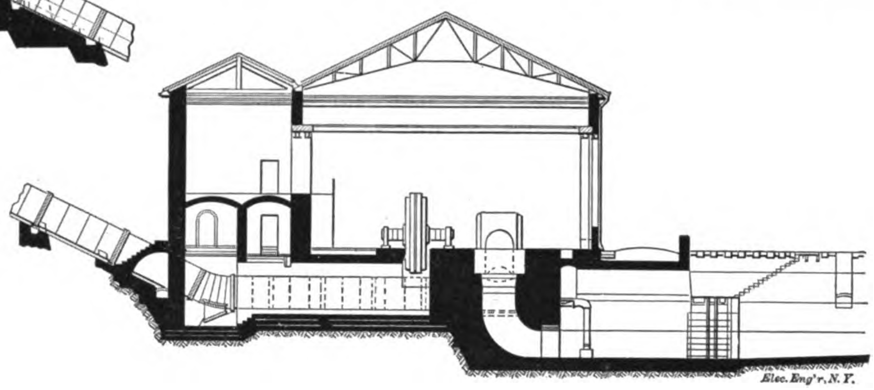


Fig. 3.—Paderno Hydraulic Power Plant, Showing Section of Forebay and Power House.

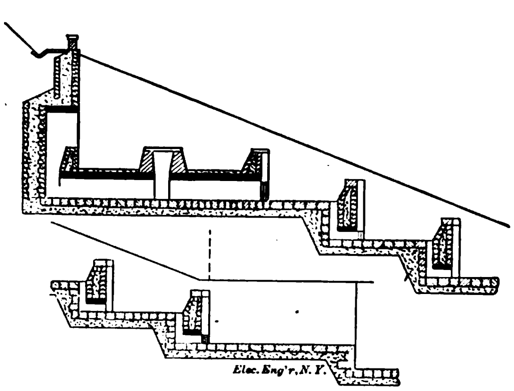


Fig. 4.—Section of Sluiceway.

The sluice way has been built as far as possible from the electric station. Its use will be to discharge the excess of water when the station is not operating all the turbines and it might discharge even the total flow of the canal in the improbable case that the station should suddenly be entirely shut down. The water discharged from the sluice way and from the turbines enters the old navigating canal which had to be prolonged 1,650 feet south of the point where it re-entered the river before.

The cost of the hydraulic work above described was estimated at $620,000, but now that the work is nearly completed, it is expected that, owing to important simplifications in the first plans, a saving of about $80,000 will be realized so that the cost per theoretical dynamic horse power will be $31, excluding the expenses incurred by the Milan Edison Company previous to the execution of the work.

The mechanical plant will consist of seven turbines, one of which as a reserve, of the Jonval type, on horozontal axes, with a total capacity of 2,180 mechanical h. p. The turbines are under construction at the shops of the Italian firm of Riva & Monneret.

The dynamos will be seven three-phase Brown alternators of 2,180 h. p. each, directly connected to the turbines, with an e. m. f. of 13,500 volts, 42 periods, and 180 revolutions. The exciter is mounted on the same shaft. The alternators have their armatures fixed and their inductors movable. The switchboard will permit of operating two independent lines in case the two services, for light and power, cannot be made to operate together.

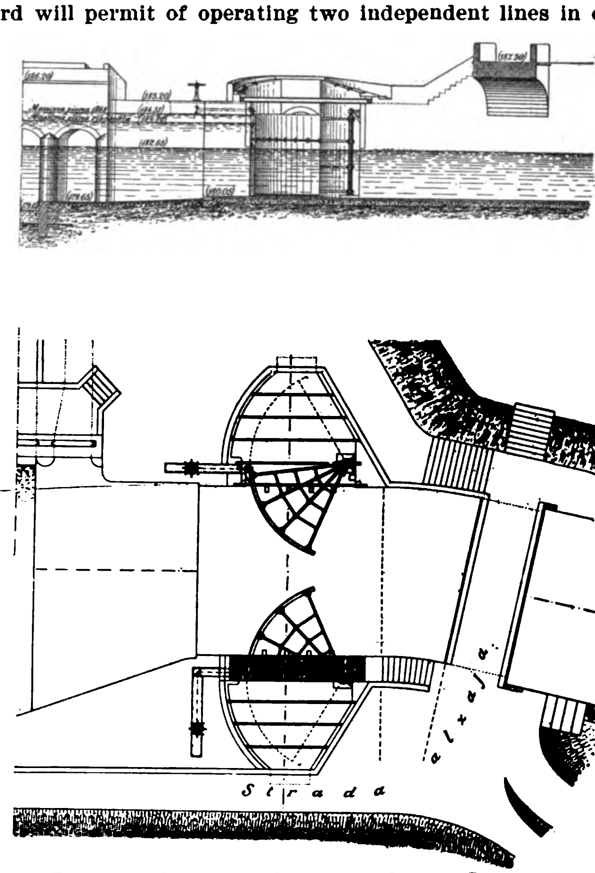


Fig. 5.—Circular Swinging Gates in Inlet Canal, Paderno Power Plant.

The transmission line to Milan will have 18 conductors of 9 mm. diameter supported on two rows of iron posts. Each post to carry nine conductors; distance between posts, 200 feet. The insulators will be without oil. The watt loss on the line is calculated to be 9 per cent. at full load on the assumption that the difference of angle of phase will correspond to the angle whose cosine is 0.85.

The e. m. f. at Milan will be normally kept at 12,000 volts. In the receiving station at Porta Volta the transformers will step down to 3,600 volts. In this station there are already installed and operated five steam engine-generators supplying three-phase current of 42 periods and 3,600 volts. These generators supply current transformed for the electric tramways and the electric lighting of the City of Milan. The units at Porta Volta station are 1,000 h. p. compound Tosi engines, each one direct connected to a Brown alternator, and two 200 h. p. tandem Tosi engines, each one connected by belts to a Brown alternator.

The alternators at Porta Volta station send a portion of current to the S. Radegonda distributing station where are installed two motor-dynamos transforming three-phase alternating current from 3,600 volts to direct current at 550 volts for the tramway service, and five motor-dynamos transforming the high tension alternating current into direct current at 115 volts for the local lighting service.

The other portion of current generated at Porta Volta is directly distributed to the outskirts of the city either for illuminating purposes or for power use. When the transmission lines from Paderno are in operation, the generating station at Porta Volta will become a receiving station and the generating units will only be kept as a reserve, insuring in any event the continuous operation of the city tramways and electric lighting supply.

ELECTRICITY IN COTTON MILLS.[1]

BY W. B. SMITH WHALEY.

ELECTRICITY as a means of transmitting power has been considerably dealt with in several very able papers before this society; and it is not my purpose to take up valuable time in covering again ground which has been only too well and ably investigated, desiring to give only the results of my experience with electricity as a means of transmitting power in a cotton mill. Its many useful dispositions have been described fully, but in every case we lack direct comparison from actual practice which would picture it to us in its true commercial light. It is the purpose of this paper to attempt to describe from the actual operation of two plants working under as nearly identical conditions as two manufacturing institutions can—the one operated by rope transmission with heavy head shafts, sheaves, etc., and the other by means of motors distributed throughout the building. In one the actual operation of the steam engine is considered; in the other the current is supplied to the motors from the secondary switchboard or receiving station.

Many have considered electric transmission in the light of a source of power, and we often hear comparisons on it with regard to power costs which are very misleading. Some have been imprudent enough to assert its economy for power purposes in connection with uneconomical water power plants, as the means of making such developments commercially available; and several large plants for cotton mills have been developed on this line with such blindness as to their true commercial value from an economical standpoint that room is left for well-founded scepticism of their true value when compared with the many other more economical installations which might have been effected. Electricity's true position, for power purposes, is that of a transmitter; and whatever the source of power, the point to be considered is its efficiency in connection with that source for transmitting purposes. Having settled that, our investigation then leads to its comparison with other well-known methods of transmission.

For the purposes of this paper we will take up the investigation, by tabulated data, from the actual every-day operation of the plants. The period during which the conditions as regards the working load were approximately the same was between the 1st of April and the 25th of June, 1897, and we shall designate the two plants as No. 1 and No. 2. No. 1 is a steam-driven mill, having a steam plant geared up with ropes, heavy head gearing, and large tapering shafts as such plants are usually geared up in the best practice of to-day. The steam engine is an 800 h. p. Corliss cross compound, built in 1895, with cylinders 20 and 40 by 60 inches stroke, and a rope wheel 24 feet pitch diameter, grooved for twenty-six 1¾-inch ropes, weighing 35 tons. This engine is being operated at an exceptionally low cost per horse power for steam. There was in the mill during the period for which comparison of power is made 11,776 spindles and 720 looms; all the spindles and preparatory machinery were run full, but the looms did not average more than 682 per day. No. 2 is an electric-driven mill which rents its current from a central station and distributes it through a continuous-reading wattmeter to four 150 h. p. inverted motors bolted to the ceiling in convenient locations for economical distribution of the power, and belted to the shafting. The mill has been in operation since the 1st of January, 1897. This mill had in operation during the period named above on an average 12,448 spindles, with preparatory machinery, and an average of 356 looms out of 500 in the mill. The weight of the shafting in the steam mill is approximately 136,000 pounds, and in the electric mill 122,000 pounds.

[1]Presented at the New York meeting of the Am. Soc. Mech. Eng., December, 1897.

POWER IN EACH MILL.

From the diagram (Fig. 1) showing the power curves in the two mills during the period alluded to, we find that the average in the steam mill is 535.71 h. p. for all purposes (this mill is only partly filled with machinery and is using not quite two-thirds of its full power). From indicator cards taken, we find that the power required to drive the shafting and belting on loose pulleys only is 228 h. p.; for the 720 looms and shafting, only 349 h. p.; and for the whole mill, 595 h. p. Deducting the friction horse-power from the power required to drive the looms and shafting and dividing this result by the number

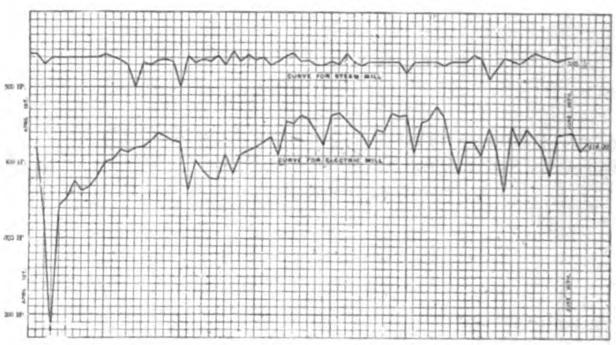


FIG. 1.

of looms, we obtain the power required to drive one loom, which is 0.168 h. p.

Deducting the power required to drive the looms and shafting from the total power gives us 246 h. p., which is the power required to drive the spindle and preparatory machinery. This amount divided into the number of spindles gives us 60 spindles per diem and 357 looms, as against the steam mill machinery for this number of spindles.

At the time the data given above were obtained, there were in operation in the mill 14,848 spindles, with the necessary preparatory machinery, and 720 looms.

In the electric mill, owing to the lack of suitable instruments for testing the separate motors, we were unable to find the amount of power expended in friction, and consequently, having only the average power consumed, we can compare the mills by using the data obtained from the steam mill to bring the electric mill to the same basis. From the power chart we observe that on an average 418.2 h. p. per day were used in the electric-driven mill during the period above alluded to, namely, from the 1st of April to the 25th of June. During that period there were in operation on an average 12,448 spindles per deim and 357 looms, as against the steam mill operating 11,776 spindles and 682 looms.

From the data obtained from the steam-driven mill we have the following distribution of power during the test—for the steam-driven mill,

Total Power.	Looms and Shafting.	Friction.	H. P. Speed.	Looms
535	340	226	196	114

and for the electric-driven mill,

Total Power.	Looms and Shafting.	Friction.	H. P. Speed.	Looms.
418	206	149	208	60

Hence the difference between 226 h. p. and 149 h. p., which is 77 h. p., must be credited to the electric mill in its present condition.

The following points from the foregoing can be stated as existing under the present conditions: the steam mill is operating under a disadvantage of an underloaded engine; the electric mill is operating under the disadvantage of driving more shafting per motor than it will when the full complement of machinery is installed.

The steam mill requires more supplies in the shape of oil, sizing for ropes, and other necessary incidentals due to the method of transmitting the power. The electric mill has cost nothing for its motors in six months of operation, not even the necessity of putting oil in the bearings, which was simply renewed once in that time as a precaution. The convenience of operating any section of the mill "ad libitum," without reference to the other sections, is an advantage which is felt in dollars and cents in plants using the electric transmission.

The question which arises as to whether a generator directly connected to an economical type of engine to produce the power would consume the difference in the frictional horse-power, is one which can only be answered from data from institutions having such plants. It is the author's opinion that this difference of power would not be exceeded, and he hopes subsequently to give more specific data from further experiment from the actual operation of these two plants under better conditions, viz., when both mills are completely filled with machinery and motors and engine run at their full load; also in obtaining the efficiency of direct connected engines and generators.

It must be borne in mind that, unlike a machine shop and other manufacturing establishments, where a large amount of shafting is required to cover the ground and where intermittent power is used, a cotton mill drives in useful effect 95 per cent. of its shafting and uses actually in continuous operation almost the maximum power at all times.

In presenting this paper the author hopes that it will awaken enough interest in others to induce them to collect and present to the society useful data which they may have relative to this very important subject.

TELEPHONY AND TELEGRAPHY

THE PRACTICAL APPLICATION OF THE COHERER.

By A. C. BROWN.

THE coherer, or Branly filings tube, including various single and multiple contact modifications, as all the scientific world now knows, is the vital feature or soul of the Hertzian system of wireless telegraphy; and so much nonsense has been written around this subject in the lay press, and so much misconception prevails even in some scientific circles as to its possibilities and probabilities, that the present article has been written by desire to endeavor to clear up the ground and lay before the readers of "The Electrician" a statement of the actual facts of the case, as to what will and what will not probably be the commercial uses of the coherer in the near future. The subject is here dealt with as it appears to one who has been working on various forms of wireless telegraphy since the year 1878, beginning then with the photophone (or light-beam transmission with a selenium "electric eye" and telephone repeater) in conjunction with Prof. Alex. Graham Bell, and going through and experimentally testing most other methods of transmission that have since presented themselves, including electro-magnetic induction in 1879; thermal-ray transmission with thermophile telephone, and various thermo-electric resistance-varying cells or "eyes," also in 1879; sound wave transmission with electro-magnetic receiver ringing bell or making signal locally at receiving station, in 1885; trying even Röntgen rays for signalling purposes in 1896; also in 1896, the Hertzian or electric wave method of transmission, now so greatly to the fore.

This article, however, relates not to wireless telegraphy in itself, but to the coherer—which piece of apparatus certainly more than other has rendered the former a possibility— because it appears to the writer that there are other practical applications and probable commercial uses to which the latter will be put, which may even outweigh in importance its use in connection with wireless telegraphy. The practicable uses of the coherer may be summarized as follows:

1. Wireless telegraphy proper over moderate distances including, say, ship signalling, military telegraphy, and especially municipal telegraphy such as fire and police alarms, etc.

2. The cases where a contact or any short distance requires to be bridged across without direct connection, but where a wire can and is advantageously run for the greater part of the distance to be communicated over, and which cases cannot therefore strictly be classed as wireless. These especially include railway signaling, lightship cable connections and working through breaks or faults in ordinary submarine cables.

3. Relay purposes for ordinary telegraphy, especially submarine.

4. An application which the writer has worked out, viz., for telegraphing over long lengths of bare submerged wires or uninsulated submarine cables, which may consist of simply strands of some of the present covering or protecting wires without any core. The possibilities in this respect seem, in fact, to the writer to be among the most important of all applications likely to be found for the coherer.

Among the applications which are not likely to be found practicable—at all events not immediately—may be mentioned:

Long distance wireless telegraphy, such as was promised but a short time since by the public press, backed up unfortunately to some extent by scientific men, viz., 20 miles, England to France (23 miles), then "possibly across the Atlantic," then 60 miles, etc., such promises being now reduced in reality to almost a single figure. Variable atmospheric electric conditions appear to prevent any likelihood of long-distance transmission, even if the sensitiveness of the apparatus could be sufficiently increased. The coherer is also not just yet going to synchronise the watches in our pockets.

Wireless Telegraphy Proper.—Before going into the various branches of this application, it will be, perhaps, best to mention a great practical limitation, which at present applies to all cases. I refer to the impossibility of preventing a coherer from being affected by all electric waves arriving in its vicinity, if it is to respond sensitively to any of them. In this regard a great deal has been made about electric syntony and the supposed possibility by its means of confining to each receiver the signals intended for that receiver only, notwithstanding the simultaneous transmission of many other electric wave signals across the area through which it is sensitive; but the writer ventures to assert that no electric syntony whatever has yet been obtained with the Marconi form of Hertzian apparatus over any distance exceeding, say, a quarter of a mile; and certainly such a close syntony as would be necessary to pick out one signal from a simultaneous batch of three or four, while rejecting the others, has not yet been made at all; nor does it seem likely that it ever will. Hertz in his laboratory, and probably, Dr. Oliver Lodge and others, may, no doubt, have obtained true syntony and some selective power over short distances, but for all useful distances in real work the elevated conductor and earth connection have been necessary, and with these there can be no syntony. The continually varying leakage and inductive capacity arising from hygrometric and atmospheric variations and other causes would entirely and continuously alter the time period of such conductors, and thus destroy the syntony even if any could be obtained, but in practice with this apparatus none can be secured at all. A nearer transmitter though, wrongly rated, will affect a coherer circuit, as much as a distant transmitter circuit properly syntonized. The only possibility of selective syntonic transmission over fair distances appears to be by means of nearly closed metallic circuits, which for distant transmission must be of considerable magnitude. Fortunately, however, the coherer does not necessarily need that a syntonized circuit should cause oscillations. A single impulse is sufficient to make a signal, and this in itself indicates the futility of attempting syntony for selective purposes. Much the same may be said of the idea of selecting by varying the plane of polarization of the waves; also, to a less extent, of mirrors and the like. They are all only available within earshot.

In this connection an incident that happened at Mr. Preece's Royal Institution Lecture may be noted. After Mr. Preece had sent a signal on the wings of Hertzian waves to the coherer the receiver with its "tuned" wings had to be put into a metallic box, to show its power of working therein, but had to be doubled up to get it in, thus entirely altering the capacity and time-rate and destroying any syntony that might have previously existed. The receiver worked all the same, which was very obliging on the part of the coherer, but bad for the syntonists.

As a matter of fact, a coherer will work if the transmitter be sufficiently powerful with any and every length of wing, and at short range like that, with no wings at all. Other and altogether different means of selection than anything which can be done to the circuits will have to be found, and to this point the writer has been specially addressing himself in a long series of experiments.

Coming now to the branches of wireless telegraphy wherein the coherer may be useful:

Ship Signaling.—For communicating between passing liners, etc., and for warships, this application seems, however, to be greatly limited by the means at present available for selecting signals. It probably will be of some use to a fleet of war-

ships for signaling among themselves in time of peace, but could be of little use in time of war. An enemy's ship desiring to prevent signaling, for instance, has only to keep a transmitter continually generating electric waves to entirely prevent intelligible signaling anywhere in the vicinity. The methods of applying the coherer in these cases present no features of novelty, and it is not the purpose of this article to repeat the description of ordinary methods of Hertzian wave telegraphy. While speaking of ironclads, however, another matter requires reference. Capt. Kennedy, in a letter appearing in "The Electrician" of 29th ult., implies that the Marconi apparatus is better than anything that has gone before, because no one has hitherto worked such apparatus inside an iron box. Who has wanted to? In regard to about the only evident application where such might be of any use, viz., for an ironclad, the writer asserts that it can only be done now for very short distances, unless a collecting wire projects out of the ironclad, say, up the mast, or other convenient position, as in practice it would; and if this is done it matters not one jot where the rest of the apparatus is placed. Similar apparatus has long been worked in metallic boxes in this condition and for short distances without the projecting wire.[1]

Military Telegraphy.—This, again, is greatly limited by the difficulties of simultaneous signaling within a considerable area; and the coherer, with its accessories, has here also formidable competitors in the heliograph and flag, and other ordinary signaling systems. Still, some considerable use will no doubt be made of it in this application. It will be very convenient for the telegraph corps of armies in comparative security to be able to ring a bell or work a sounder, and so call attention at the receiving end, without continually watching for signals; but in action the signaling detachment would, of course, always have to be on the lookout, so that this advantage would not hold. Hertzian wave signaling is also available across districts which might be clouded with powder smoke or otherwise where sight signaling is not; but, on the other hand, electric signaling, as in the case of ships, could often be easily upset by the enemy; and in any case as arranged at present, only one pair of signaling parties could be allowed to work within a considerable area if they are to signal across any but very small distances.

With present apparatus there would no doubt be a frequent difficulty in getting sufficient elevation for the collecting wires to allow of distant signaling. Kites and balloons cannot be kept flying in all weathers and under all conditions, and tall masts are not appliances desirable for rapid military transport and quick erection. Horizontal base lines can, however, frequently be secured with far less trouble.

Referring again to Capt. Kennedy's letter, he gives figures which show that length of horizontal wire is worse than useless with the Marconi apparatus, but it does not appear to have struck him or the experimenters, that this was the fault of the apparatus, and not of the wires, in generating and attempting to use currents or impulses unsuited to the circuits between which mutual induction was then required. By adopting suitable arrangements, so as, among other things, to apply the slower varying received current in sudden impulses to the coherer, the writer finds that the latter can be far more simply operated by ordinary electromagnetic induction over considerable distances and without either tall conductors or any high tension complications. This method of working opens up another large field for investigation, and is the subject of a recent patent.

Municipal Telegraphy, as Fire Alarms, Police Communications, etc.—This application the writer believes to be the most important and immediately available of all the applications of the coherer to wireless telegraphy, and to it therefore he has given the most attention. In this application the necessity for a good selective system is greater than ever. It is not enough merely to ring a bell at a fire or police station, the officials must also be told immediately and certainly from which point the call comes. Moreover, they must not be called up by every stray Hertzian wave that anyone may choose to send along "for a lark," or produced by other mutual signaling in the neighborhood, if such should become popular; and the whole apparatus must be of very great certainty of action to be sufficiently reliable. The power of sending a reply signal is also a necessity. It would make this article far too long to describe in detail the full arrangements for accomplishing the above results. Such a system has, however, been worked out and tested in practice depending on mechanical harmonic vibration, and it may suffice to say that one of its features depends on the fact that while it is impossible to prevent a coherer, which is required to work through a considerable distance, from being affected by all electric waves produced in its vicinity, it is easily and with great certainty possible to cause the receiving instrument which the coherer controls to be affected only by the particular rated set of signals intended for it out of a very considerable number of such sets, which may simultaneously or successively affect the coherer; and out of a considerable number of Morse or other signals passing around.

2. Proceeding to the second field of application for the coherer mentioned above, the effective bridging of a small space without contact, we come to:

Railway Signaling.—Here there is a large field for putting signals directly on to running trains. There is no difficulty here in running wires, but the signals must be confined with great certainty each to its intended train. This can be done by running a wire from the signal box parallel with the rails, or by using the latter themselves as conductors, divided off into proper sections by insulating joints at the required fish plates, and providing the engines with a coherer and accessories connected to a small inductor or inductive circuit opposed to the line circuit over which the signaling impulses are automatically sent.

Lightship cable connections can also be made, without directly leading the cable on board the ship, by means of bare wires either acting through the ship's wire hawser or chain, or a special wire lowered near to the looped bare end of the cable—not necessarily into contact therewith, but sufficiently near to cause the cable currents to affect the sensitive coherer on board—and so ring a bell or produce Morse signals, but in this case the telephone can also usually be applied without direct connection to speak after attention has been called by means of the coherer and bell.

Broken or disconnected submarine cables, providing that the ends remain anywhere in proximity, can also usually be signaled through by using a coherer as indicated in its next described application.

3. Relay Purposes for Ordinary Telegraphy.—This is doubtless another very large field of application for the coherer. Wherever for any reason the received current on a telegraph line is reduced to very small proportions, the coherer—if properly applied in conjunction with other accessories to disintegrate the received current and apply it in sudden impulses to the coherer—forms a most exquisitely sensitive means of appreciating and translating from those currents when reduced even to such an extent as to be inappreciable on any other form of ordinary electromagnetic receiving apparatus at present in use, including even a telephone.

4. Working through Bare Submerged Wires or Cables.—This appears to be a very important application, and to which the writer has given a very great deal of attention. This application, of course, follows from the same properties as recorded in the last paragraph, viz., the extreme sensitiveness of the coherer to infinitesimal impulses when properly applied. It appears, no doubt, at first sight, a very unlikely thing to be able to transmit signals through a great length of bare wire immersed in the sea, but it will be quite obvious that the more sensitive the receiving instrument the greater the distance along such a wire at which it will be affected, and that therefore as the sensitiveness of the receiving apparatus approaches infinity so may the length of bare wire through which it will work be indefinitely increased, and the coherer carries sensitiveness to electric impulses nearer to infinity than anything else with which we are at present acquainted. It is conceivable, too, that some effect must take place throughout the whole length of an immersed wire on the application of a current or electric impulse at the sending end, however long it be and whatever be the proportion of current which leaks off to earth; and a rhythmic oscillatory or surging wave transmission can also here be applied, and the originating currents or impulses made very powerful. Over what maximum distance a bare cable can be worked in this way would be very costly to determine, because, unfortunately, the present outer covering of a cable is not suitable for the experiment without cutting the cable out at sea clear of crossings or metallic connections with the outer coverings of other cables; but it appears certain that the result in miles will not be expressed in units, and may probably run into three or four figures.

Such, in the writer's opinion, are the chief features, conditions, and limitations of the present and prospective practical applications of the coherer.

INDIANAPOLIS, IND.—A new opposition telephone company is in the field, which proposes to do business at the rate of 75 cents per week for business telephones, 50 cents for residence and 25 cents for party lines. It talks of equipping with 10,000 lines.

[1]See "The Work of Hertz," p. 30 (published by "The Electrician" Publishing Company in 1894), wherein Dr. Oliver Lodge speaks of the difficulty of preventing such apparatus, made prior to 1894, from working when inclosed in a metallic box, which may be iron, without appreciable difference.

LIFE SAVING ALONG THE COAST BY TELEPHONE.

The total length of life-saving telephone lines is, it is stated, nearly 1,000 miles, and there are more than 200 telephone connections at life-saving stations, half way places, light houses and other points in connection with the service covering the Atlantic coast from Maine to Hatteras Inlet, N. C. Linemen's work on the coast is not a pleasant duty, the trips being long, with dangerous inlets to be crossed, and there is but little shelter on the beaches in stormy weather. The one man who has charge of the 160 miles of the North Carolina section has to make most of his trips on muleback. At some points on the coast of Cape Cod the half-way places are connected by telephone with the main line.

The designation of "half-way" is applied to a place about midway between two life-saving stations, where the patrols meet and exchange checks during the night watches. The object in connecting the half-way places is to enable the patrols to send in an alarm of wreck or report vessels that may be in distress in the vicinity of the half-way place without having to run back through miles of loose sand, and perhaps in the face of a gale, to notify their station. Many a time when, in the old days, this had to be done, the ship and crew were under the water before help arrived, that now would have been saved.

This telephone service is also used in calling tugs to go to vessels in distress at sea, to notify owners and underwriters of disasters, to watch disabled vessels, and in isolated places to call up a physician or substitute patrols in case of sickness, etc. Every section is connected with some telephone office where telegrams can be sent and received.

EARLY TELEGRAPH APPARATUS FOR THE SMITHSONIAN MUSEUM.

A dispatch from Baltimore, of November 20, says: Among the possessions of the late Rev. Dr. Henry Scheib, the venerable pastor emeritus of Zion Church, there was recently brought to light what is beyond a doubt the first telegraph instrument ever constructed for practical use. In connection with this discovery, it has now been ascertained that Dr. Scheib was for many years an intimate friend, confidant and practical adviser of Prof. Samuel F. B. Morse, the father of the telegraph. Several years before his death Dr. Scheib told Prof. Richard Ortmann, of this city, of the history and existence of the old instrument, with the instruction that it be sent to the National Museum at Washington after Dr. Scheib's death.

There is also now at hand undoubted proof that the first practical working line of telegraph was constructed between Dr. Scheib's school and his church, on Gay street. Before Congress appropriated the money with which the first line was built between this city and Washington, Prof. Morse and Dr. Scheib had the line in practical working order between the school and the church.

It was this line which showed to John P. Kennedy, of this city, then chairman of the House Committee of Congress, the demonstration of the practical utility of the scheme, and which gave him the inspiration to make a gallant fight at Washington, as the result of which an appropriation was passed granting $30,000 for the construction of the Baltimore-Washington line. That was the line over which the first telegraph dispatch was sent for any distance.

Prof. Ortmann said yesterday that he would immediately take steps to present the instrument to the National Museum, according to the request of Dr. Scheib.

A TELEPHONIC GOOD-BYE WOULD NOT DO.

Kaiser Wilhelm was not long ago about to leave Berlin, and as he returned from his daily drive he stopped at the Austrian Embassy to visit the Ambassador before his departure. Some interesting political event had just occurred and the diplomat and his august visitor became so engrossed in conversation that time sped on unnoticed. Suddenly the Emperor started, and, glancing at his watch, exclaimed with genuine consternation: "I am too late! Pray connect the telephone with the palace; I should like at least to take leave of my wife in that way." His Majesty's wish was instantly fulfilled and affectionate messages were sent to and fro from the imperial abode. Then the Kaiser rung up the "'phone" and exchanged a few last words with his host. As he was in the act of taking leave, one of the palace carriages dashed up to the Embassy and before he and the Ambassador understood what had happened the Empress stood before them in a gorgeous dressing gown and with an ermine-lined cloak—the first thing which came to hand—hastily thrown over her shoulders. With one of her delightful smiles she apologized for her sudden advent, saying: "I beg Austria-Hungary's pardon for appearing in morning toilet, but I cannot let my husband depart without bidding him farewell.

MECHANICAL

THE COMPARATIVE COST OF STEAM AND ELECTRIC POWER.—III.

BY IRVING A. TAYLOR.

There is one condition, however, which is making electricity fairly fight every inch of its way into popular favor. We tried to make it clear, above, that the high value of the ratio of the constant charges to the total charges, in small steam plants, is the cause of the high cost of power when generated in small quantities. Now nine steam users out of ten never allow a tithe of the constant charges to enter into their calculations, and hence they never have the least suspicion that their power is costing them a fairly large amount, but, in their guileless innocence, think that they are getting it for very nearly nothing. Add to this the fact that most of them, in a vague kind of way, think that they are using two to three times as much power as they actually are, and we have a condition—an aggregation of erroneous ideas with which electricity is finding it difficult to cope.

Electric power, as an actual fact, may be cheaply supplied; but, as a mere physical force, it has not the power to convince men of its cheapness. Why, it is a common occurrence to hear a factory owner, who is operating a 25 h. p. to 50 h. p. steam engine on a variable load, say that his power costs him 1, 2, or 3 cents per h. p. hour. Men who have the least idea of what their power is costing them are extremely rare. The writer talked, some time ago, with the superintendent of a large establishment operating a 200 h. p. engine for 6,160 hours per year, i. e., 20 hours per day, and was informed that their power cost, when all things except rent were considered, 2 cents per h. p. hour, on the basis of a load factor of unity. The cost in this case is not exceptional, but it was exceptional to find a man who knew it.

It is quite evident that, with any given load factor, there is a certain power under which, on the score of cost alone, it will be cheaper to buy electric power from a central station than to generate it in an isolated steam plant. We shall endeavor, in what follows, to trace the various costs of steam and electric plants worked under varying conditions, and to get some idea when it is cheaper to use electric power, and when steam.

It may be thought that the load factors chosen are exceptionally low; but a large number of tests made during the past few years have convinced the writer that low load factors are the rule, not the exception, when averaged for a year. The following factors are not, properly speaking, load factors, but should be called "factors of plant loading," as they represent the ratio of average load to the rated load of the plant, and are therefore somewhat lower than load factors; but the name, "load factor," will be retained, as it is simpler, and with this explanation will not be misunderstood. It is thought that most cases of variable power consumption will fall between the limits chosen. As a matter of fact, load factors of unity are of great rarity, even in plants where the load is perfectly constant and where the size of engine has been designed for the load with considerable intelligence. One finds that, for plants below 100 h. p., or perhaps more, so-called "constant loads" will generally have a load factor—in reality a plant factor—between .50 and .75. This, of course, is not on the indicated horse power of the engine, but on the brake horse power.

However, in order to cover the field of cost as nearly as may be, we will assume steam and electric power plants having three different classes of load factors: I. Load factors of unity. II. High. variable power, load factors. III. Low, variable power, load factors. We will divide our estimates, following, into cases I, II, and III, respectively, so that we may consider as a separate case each of the above classes of load factors.

No attempt will be made to take into account the saving which may, and generally will, accrue in the power cost, from the more direct application of the motor to the load in the electrical cases, as this varies widely in different situations and can generally be roughly estimated in any particular instance.

In all cases power is supposed to be used for 10 hours per day, 308 days per year, making a total of 3,080 hours per year. A greater number of hours would be favorable to steam power; a less number would be favorable to electric power. Under each case will be considered plants having four different sizes of motors and engines, as follows: 10, 25, 50 and 100 b. h. p. (brake horse power).

TABLE I.—COST OF PLANT.

Nom. h. p. of boilers	27	55	90	160
Brake h. p. of engines.	10	25	50	100
Water tube boilers	$736	$1,138	$1,740	$2,680
Setting boilers	185	250	305	493
Cartage of boilers	1[illegible]	15	30	40
Piping to engines	75	110	185	353
Feed water heaters	60	100	148	332
Feed pump with connections ...	84	130	196	253
Feed injector with connections..	77	103	118	166
Pump and heater foundations ...	1[illegible]	18	21	28
Iron stack erected	60	98	125	300
Simple horizontal engines	300	720	1,160	1,700
Foundations for engines	65	75	85	130
Handling and setting engines ...	75	90	100	115
Boiler and engine room const'n..	136	166	190	205
Incidentals	94	151	220	340
Total cost of plant	$1,976	$3,164	$4,623	$7,135

Load factors will be taken as follows: Case I, load factor of 100 per cent. Case II, load factor of 46 per cent., made up as follows: 5 hours per day at 30 per cent. of load; 3 hours per day at 50 per cent. of load; 2 hours per day at 80 per cent. of load. Case III, load factor of 18 per cent., made up as follows: 4 hours per day at 10 per cent. of load; 4 hours per day at 15 per cent. of load; 2 hours per day at 40 per cent. of load.

TABLE II.—YEARLY CHARGES ON THE PLANT.

	10 h. p. Engine.	25 h. p. Engine.	50 h. p. Engine.	100 h. p. Engine.
Insurance	$19.76	$31.64	$46.23	$71.35
Rent	110.00	125.00	150.00	200.00
Interest	118.56	189.84	277.38	428.10
Depreciation and repair	189.80	310.2[illegible]	462.78	726.22
Total	$438.12	$656.74	$936.39	$1,425.67

STEAM POWER.

As small plants are almost universally non-condensing, only this class will be considered.

Labor costs per year will be approximately as follows, case I being somewhat higher than the others because of the increased attention and work necessary with a high load factor. Case I: 10 h. p. engine; man at $780 per year, employed on engine 60 per cent. of the time; cost = $468.—25 h. p. engine; man at $780 per year, full time given to engineering duties; cost = $780.—50 h. p. engine; man at $936 per year, full time; cost = $936.—100 h. p. engine; man at $936 per year, and fireman at $624 per year, full time; cost = $1,560.

Cases II and III: 10 h. p. engine; man at $780 per year, busy on engine 50 per cent. of the time; cost = $390.—25 h. p. engine; man at $780 per year, busy on engine 75 per cent. of the time; cost =$585.—50 h. p. engine; man at $780 per year, busy all the time; cost = $780.—100 h. p. engine; man at $936 per year, busy all the time; cost = $936. Labor may be obtained more cheaply than the foregoing, but it is very doubtful economy.

Petty supplies, such as oil, waste, tools, etc., per year, will cost approximately $37 for the 10 h. p. engine; $78 for the 25 h. p. engine; $128 for the 50 h. p. engine; $200 for the 100 h. p. engine.

Removal of ashes will cost about 5 cents per ton of coal used. Cost of coal will be taken at $2 and $4 per long ton. The power costs for other prices of coal can be found by interpolation. Water cost is taken at $1 per thousand cubic feet, or per 62,350 pounds.

The cost of the entire plant is detailed in table I.

The depreciation and repair rates on the boilers, together with their setting, cartage and piping, and on the heater and feed pump, may be taken at 12 per cent.; while on the injector, smoke stack and engine, with its handling and setting, the rates will be a little lower, say 10 per cent. On the other items no depreciation and repair charges are made, as the total amount on the plant can only be very roughly estimated anyway.

Cost of insurance at 1 per cent. on entire plant. Cost of interest at 6 per cent. on entire plant.

Cost of room rent for engine, boiler and coal, taken rather high on account of the nuisance: 10 h. p. engine, $110; 25 h. p. engine, $125; 50 h. p. engine, $150; 100 h. p. engine, $200 per year.

From the foregoing the charges on the plant may be made up, as in table II.

EXPANSION ENGINES FOR LAND SERVICE.[1]

BY W. H. HOFFMAN, M. E.

I HAVE selected for consideration this evening the compound, triple and quadruple expansion engine for land service. When we consider how slowly the two-cylinder compound steam engine has been coming into general use, both on sea and land, we can well look back to 1804, when Arthur Woolf designed and patented his compound beam engine. The boilers of that date, and many years after, were not calculated to carry steam pressures high enough to offer great returns in fuel economy, but the principle was there, and the engines showed gains even under 50 and 60 pounds initial pressure.

Probably one of the most compact engines ever designed

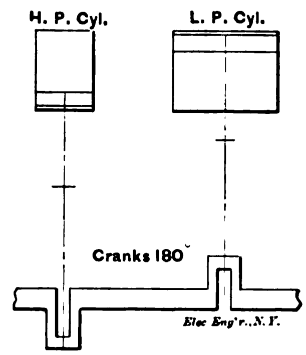


FIG. 1.

was the one built by Messrs. Fox & Co. and Harvey & Co., of Cornwall, in 1839, for pumping the Haarlem Mere in Holland. The design was entirely novel, both as to steam cylinders and the main pumps. It was a special pumping engine. The high pressure cylinder was 84½ inches in diameter and was placed inside of the low pressure cylinder, which was 144 inches in diameter. There was a single piston rod for the high pressure cylinders, piston 12 inches in diameter, and four piston rods for the low pressure cylinder's annular piston, each 4½ inches diameter. All the five piston rods were connected to a cross head that was common to all the pumps. The engine used its steam single acting in both cylinders. The economic duty of this engine was 70,000,000 pounds raised one foot high with 94 pounds of coal. The idea of one cylinder inside of another was not looked on with great favor, for, in order to make the engine double acting, as the one just described should have been, a real compound engine, the valve chest had to be attached to the cylinder heads for the inner cylinder at least. This was considered objectionable. Marine engines (double acting) were designed after this plan in England and by the writer in America many years later, but only one or two, I think, were put into actual practice, and these were small.

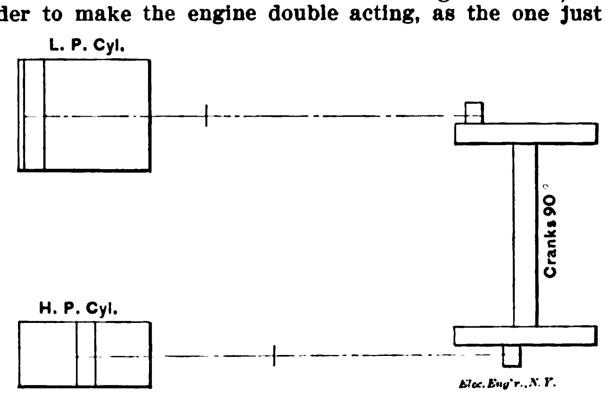


FIG. 2.

John Hornblower, the English engineer, designed in 1781 a

[1] A lecture delivered before the Mass. Assoc. of Steam Engineers, Boston. Abstract.

compound engine, but it never came into use. In 1845 Mr. William McNaught, of England, a progressive engineer, designed a compound beam engine and placed the low pressure under one end of the beam and the high pressure cylinder at the central portion of the other end of the beam; or, in other words, the high pressure cylinder was nearly midway between the beam center and the crank shaft.

In America the system of compounding was received coldly

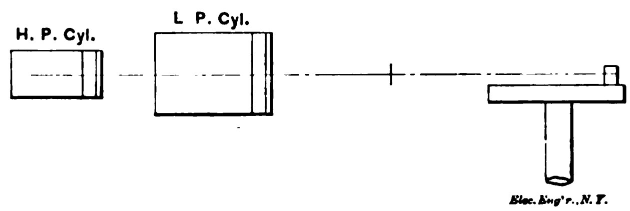


FIG. 3.

until about the year 1868. Engine builders looked on the results obtained abroad with suspicion. The American marine engineers would not, as a rule then, recommend their clients to experiment much in this direction. Some of our American engineers of the great lakes were bold enough to go "ahead," and I must say that they did excellent work, and are still doing it.

If I mistake not, some of the Buffalo and Cleveland builders were first in the field in this country with the ever popular style of marine engine shown in Fig. 1, where there are two inverted cylinders used, a high and a low pressure, with the cranks placed at 180 degs. instead of 90 degs. By this method the moving weights of transmission, such as pistons, piston rods, connecting rods, and cranks, are, as is also pressure on

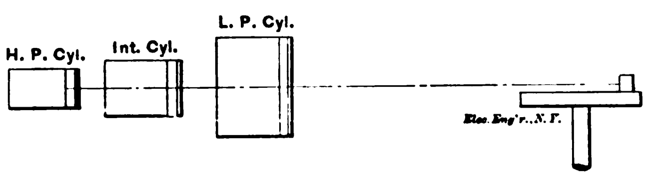


FIG. 4.

the main shaft journals, balanced, thus enabling them to run at high rotative speeds and consequent high piston speeds.

A few more illustrations will show the prevailing types of the compound triple and quadruple engines. Fig. 2 shows the usual cross compound mill engine; Fig. 3 the usual tandem compound mill engine. Fig. 4 shows some of the first triple expansion mill engines with all three cylinders in a line and the three pistons on one piston rod. Fig. 5 shows one of the more popular types of the triple expansion engine, with two cylinders in line, tandem, and the other placed "cross" at 90 degrees on the crank. Fig. 6 shows a triple vertical, using four cylinders so as to keep the low pressure piston down in size on account of obtaining high rotative speed. Fig. 7 shows one type of the quadruple vertical engine, and Fig. 8 another type of the same.

Such engineers as Mr. George H. Corliss did not look with

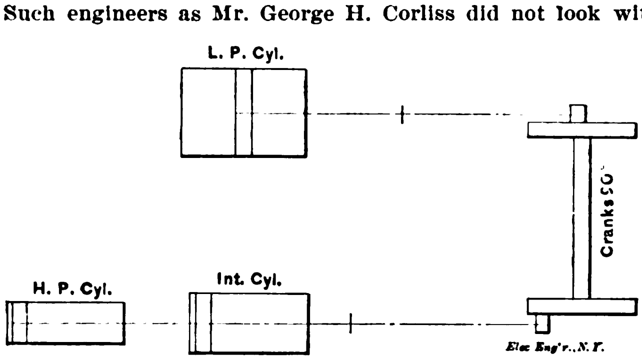
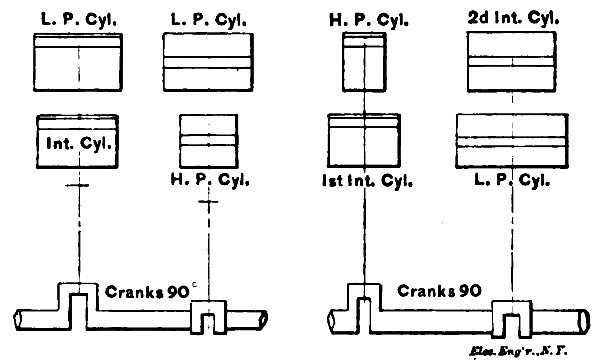


FIG. 5.

favor on the multiple cylinders for increasing the number of expansions. They claimed that if one cylinder would not produce the result, the addition of the second, third or fourth cylinder could not possibly help the matter. It is related that one of the most prominent American automatic engine builders stated that he had experimented with one cylinder enough to show the fallacy of compound systems. He said that in one cylinder cutting off from 1-10 to 1-20 the loss in economy was very great and in two or more cylinders it would be greater.

It is a great pity that he did not make his comparisons from 5-10 cut-off to 1-20 cut-off in his single cylinder. He would have found that at the 5-10 cut-off the cylinder condensation was about 12 per cent. of the steam admitted, and at 1-20 cut-off about 40 per cent. of the steam admitted. That is where he made his mistake, for he wholly ignored the matter of the great difference in the temperatures at the beginning of the stroke and the end of the same. A difference in the range of temperature of 150 degs. or more was of small amount to him, but that was the key to the whole question.

Just refer to your steam tables and see what that early



FIGS. 6 AND 7.

cut-off meant in a heat engine and you will see at once that the only way to avoid that great change in temperature is first to divide up the number of expansions by doing work in more than one cylinder, so as to have no very early cut-offs in either, thus preventing radical changes in the temperature of each cylinder. Then again, you introduce a shut-off between the heat generator (the boiler) and the cooling device (the condenser) and that shut-off is the high pressure cylinder. That cylinder is in direct connection with the initial heat at its greatest temperature in the cycle of the steam's performance. In that high pressure cylinder you may have from two to four expansions and do at least half the work with a small range of changing temperature, and here lies the explanation of the whole system.

If you have a boiler gauge pressure of from 120 to 145 pounds per square inch use only two cylinders; more correctly speaking, use the double system. If your gauge pressure is from 145 to 170 pounds use the triple system, and from 170

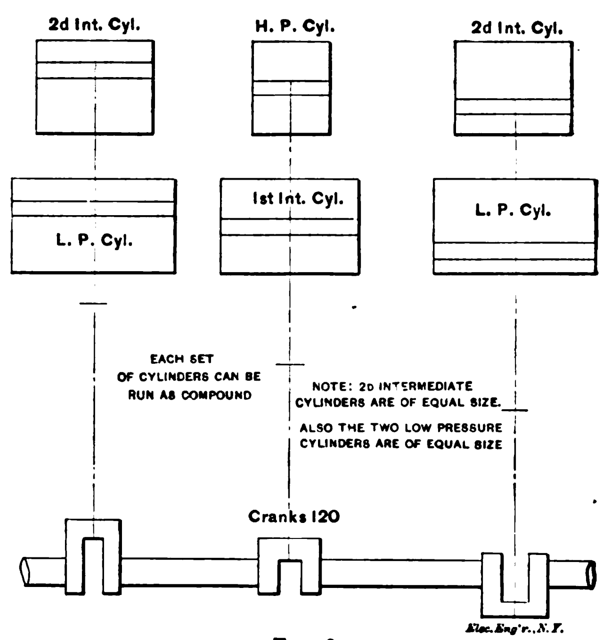


FIG. 8.

to 200 pounds use quadruple system; always remembering to fix the ratio of the capacities of the cylinders to each other to suit your initial and terminal pressures desired. Never forget that the steam engine is a heat engine and that in subdividing the range of temperature in a compound engine from, say, 350 degrees at its initial at the high pressure cylinder to its terminal, say, 150 degrees at the low pressure condensing

cylinder, you have taken precaution to save as much of that heat as possible.

Nor is the compound system confined to condensing engines. While most of the large steam engine plants in Boston are near the water front, where condensing water is available, there are several large engines in the center of the city where condensing water is not available. In but three or four instances is the non-condensing compound engine (excepting steam pumps, of course) used in our city proper. Those that are in use are successful to a high degree and the system should be used more than it is. The steam from the low pressure cylinder can be used for heating or drying, as the terminal pressure is always high enough when the ratio of the cylinders is correct.

These are some of the suggestions for you to remember and carry out if possible; first getting from your actual practice all necessary data. Examine your steam plants well, note the everyday conditions, use the indicator, register your coal consumption each day, test your boiler evaporation every three months, and then when your employer learns that you can give him this information without calling in an expert, you will find that you have raised yourself a "peg" in that employer's estimation. If you lack information on some important point ask some brother for it, or some friend of the Engineers' Association, and if he is a friend of the Association, he will freely give you the information if he possesses it. You can rest assured that the engine designers and builders, as a class, will be only too glad to inform you on the doubtful points that may confront you. They believe in education and it is a cheap way (to them) to help in that direction. Raise yourself in your profession all you can, and do this by attending the meetings of your Association and making notes of all new things you hear of there, and maintain your membership.

Returning for a few concluding remarks on compounding, let me say that the steam pressures are of vital importance. If you have no more than 100 pounds pressure at your command the system is little advanced beyond the simple engine with 85 pound of steam on sizes up to 250 h. p. (I am now speaking of condensing engines.) You should have at least 120 pounds for the two-cylinder or double system and I believe in a pressure between 125 and 145 pounds for two cylinders, according to conditions. Therefore your boilers must be safe and strong. The large cylindrical fire tube boilers either return tubular or upright, are not, strictly speaking, safe.

Several of the water tube boilers are safe from disastrous explosions, but they are not all safe from sudden fractures, as some of the prominent builders use metal—mostly cast iron—in the leaders connecting the water tubes with the steam drums; others use large stayed flat surfaces at the ends of their water tubes. I think that the boiler that is made entirely of wrought material and is absolutely free from all stayed surfaces, like the Stirling boilers, is far superior to the other types referred to. This boiler has plenty of water and steam space, and its circulation and distribution of water is of such a nature that it is impossible to expose any portion of the boiler to destructive temperatures, if ordinary care is observed; this is not the case with any fire tube boilers now in use.

You will do well to investigate the matter of boilers, and all high pressure boilers that are safe. We have had some ugly explosions in New England in the past three years, including the loss of life and a large amount of property. This is simply in your line of duty, and I know that you fully appreciate its importance.

THE VALUE OF DUST DESTRUCTORS.

Mr. J. Beresford Bolton writes to the London "Electrical Review" in regard to the dust destructors used to generate steam in the electric light plant at Shoreditch, and makes a pertinent point of great suggestiveness: Your correspondent when writing recently in reference to the dust destructor at Shoreditch, makes a great mistake, and one that is no doubt being made by many of those connected with different vestries in the Kingdom, who are anxiously watching definite results, when he supposes that the dust collected at Shoreditch is composed for the most part of house cinders and cabbage leaves. Those acquainted with Shoreditch, with its large warehouses, furniture factories and shops, know that the bulk, at any rate, of this so-called dust is principally composed of parts of packing cases, wood, shavings, cardboard boxes and the like, not bad fuel under any circumstances. I venture to say that those vestries who have decided to adopt dust destructors on the strength of the success obtained at Shoreditch, and who have nothing better to consume than house cinders and cabbage leaves, will find themselves in possession of a white elephant, and one that will require a lot of feeding.

GREENE, IA.—The Greene Electric Light Co. is increasing its capacity.

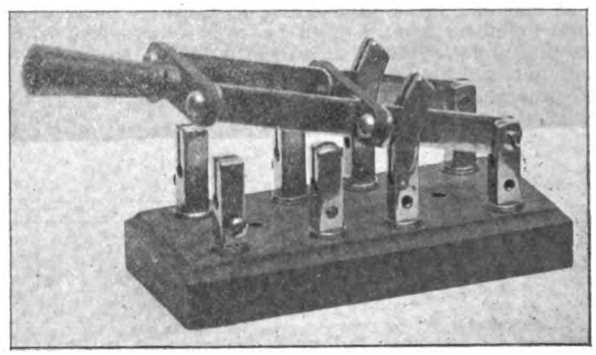
ROENTGEN RAYS

THE KOLLE DOUBLE CURRENT SWITCH FOR X-RAY WORK.

By FREDERICK STRANGE KOLLE, M.D.

EARLY during my work with the Röntgen rays I became aware of the necessity of a better switching device then that used up to quite recent times; especially do I refer to the apparatus which we term a make-and-break motor. In this arrangement we have two distinct currents, the one usually of 110 volts, to run the motor proper, while another, usually a second lead from the direct main, cut down by the introduction of resistance or preferably by a suitable rheostat, goes to the make-and-break arrangement of the motor, supplying the primary of the inductive coil with a rapidly interrupted current, which has been, up to the present day, deemed highly necessary for producing the proper excitation of the necessarily high induced current of the secondary coil.

It has often happened to men, experimenting, and even to those who are quite familiar with the work, to forget to cut down the current to the rheotome or primary coil, and in consequence of the overlapping of the brushes, usually arranged on the periphery of a revolving disk, the full current has been thrown into the coil by closing down one of two switches. Although we know it is necessary to start the motor first, many a busy skiagrapher has pulled the wrong switch, sometimes to his dismay at the results and oftener to the loss of a valuable picture.



THE KOLLE SWITCH FOR X-RAY WORK.

To overcome the necessity of two switches and the other difficulties, I have devised the switch herewith shown, early last May. It is simply a double knife-switch with raised posts nearest the hinge. The rear switch is connected with the current wires of the motor, and by being closed down to the unusually high posts throws in the high volt current, starting the motor. With a second pressure the front blades are closed down, which control the lesser current intended for the primary coil.

Inasmuch as it is necessary to shut down the current to the primary first, all that is required is to raise the switch partly, so cutting off that current. It can again be closed, with the motor running at full speed as desired. By pulling up the switch entirely, both currents are cut off, stopping both.

It is a neat little device and should be added to every apparatus made as described as its expense is indeed exceedingly small, whereas the damage resulting from the absence of it may be both expensive and serious.

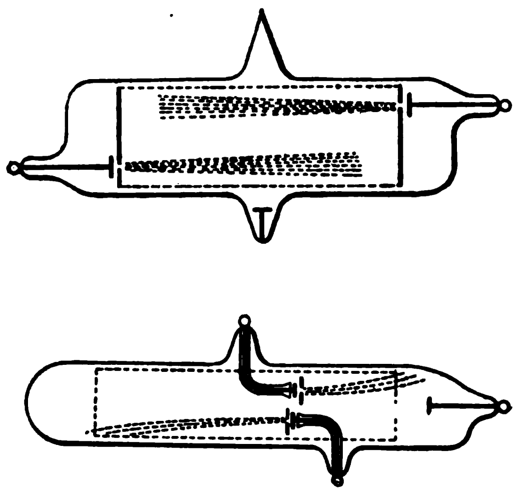
CATHODE-RAY COLORATIONS.

Goldstein was the first to discover that common salt is colored brown, and potassium chloride violet, by the action of the cathode rays. The discoverer attributed this phenomenon to some physical change undergone by the salts. Wiedemann and Schmidt attributed it to their partial conversion into sub-chlorides, and Giesel actually succeeded in preparing similarly colored sub-chlorides in a chemical way. But the chemical hypothesis is now invalidated by the painstaking researches of R. Abegg (Wied. Annal.) He obtained the salts in

question in a pure and finely powdered state, so as to be able to color them all through. His first experiments showed that the coloring does not spoil the vacuum in the tube as it should if chlorine were evolved. The salts were rendered colorless again by high exhaustion, producing rays with a strong heating effect. The substances could be colored and uncolored any number of times in succession. When the colored salt was dissolved, it produced no reducing or alkaline reaction. When undissolved in a saturated solution it retained its color. All this tells against a chemical change. Moreover, an easily reduced chloride like $CuCl_2$ is not reduced by the cathode rays. It is well to remember that the coloration of these alkaline salts is a phenomenon not produced by light. On the other hand, cuprous chloride is blackened by light, but not acted upon by the cathode rays.

MUTUAL INFLUENCE OF CATHODE RAYS.

SOME interesting experiments, accompanied by rather hesitating conclusions, are contributed by Julius Bernstein in Wied. Ann. on the subject of the apparent repulsion between two beams of cathode rays, first observed by Crookes, and interpreted by him on the supposition that cathode rays consist of projected particles, and are equivalent to elastic conductors carrying a current. As might have been expected from a German source, Bernstein's results tell against this view, and in favor of some kind of wave hypothesis. In the first place he investigated the influence of the direction in which the rays travel. Mounting two cathodes, one at each end of the tube



FIGS. 1 AND 2.

(see Fig. 1) with a slit in front of each, he obtained two opposite beams running side by side, which did not affect each other in any way. But when the cathodes were placed side by side (Fig. 2) the beams were bent outward as long as the glass funnels protecting the wires left the cathode plates bare. When they projected beyond their surfaces no effect was produced. The direction of the emerging rays is, therefore, of no account. Further experiments proved that the action is probably exerted by one cathode upon the beam from the other cathode at its origin. But to this action an electrostatic effect between the cathodes may be added.

LETTERS TO THE EDITOR

EFFECT OF CURRENT ON MERCURY.

CAN you tell me what the effect is on mercury when a continuous current of electricity is passed through it? I am told that breaking a current in mercury, no matter how weak the current may be, will rapidly destroy the mercury, but that a continuous current does not affect it. I have tried to find something about it in the text books, but they do not seem to have mentioned it.

Chicago, Ill. A. B. SIMPSON.

Answer:—A continuous current passing through mercury does not affect it. Breaking the current in mercury, however, causes oxidation, due to the heat of the spark. This in turn causes "fouling," and makes the ordinary mercury break, in induction coils, for example, unsuitable for continuous work. By breaking under distilled water or other insulating liquid, covering the mercury, so as to prevent access of air, this oxidation or fouling is almost entirely prevented.—Eds. E. E.

DEFECTS IN ELECTRICAL SPECIALTIES.

The article in the Engineer of November 25, by Mr. H. N. Gardner, is of the right sort and one which all practical workmen can fully appreciate, and is in line with my own experience this very week. I have just been wiring a residence, and in dividing my load could use 10 ampere cut-outs, which were abundantly large for the purpose, until we came to the binding posts, and there, instead of being able to use a No. 8 B. & S. wire, a No. 10 is all that we could use with any comfort for feeders, and a No. 12 was more suitable; and the result is that it is necessary to use a larger branch block than is necessary for looks or need.

Then, again, about a year ago, I had use for several three-way switches, and wishing to comply with the underwriters' rules, so far as they can be interpreted by the average mortal, I wrote to a porcelain manufacturing firm and sent a wood sample of what I wanted. Instead of the proper thing, they are making to-day a tube ⅝" in diameter, 1⅝" long under head, and with a head so large and long that it is almost a necessity to use a wood mat under the switch bases to cover the plaster mutilation, to say nothing of cutting larger holes than are needed. Of course, in putting in new work the matter is different; but few house owners would care to have paper and plaster torn off to put in tubing or boxes in a house where wires are put in afterwards.

And so on all through the chapter, and one engaged in the actual use of these "inventions" can not but wish he had the "inventor" as a helper for a season so that he might learn from practical experience just what there is of it, and there would be less "fool things" on the market.

Delhi, N. Y. H. A. WYCKOFF.

RUNNING ALTERNATORS IN PARALLEL WITH UNEQUAL LOAD.

The following question and answers appear in the latest number of the London "Electrical Engineer:"

Question.—Two alternators running in parallel, the load being 100 amperes, it is required that they should do 80 and 20 amperes respectively. How could this be done?

Answer No. 1.—The distribution of the load on two alternators running in parallel is effected by the adjustment of the governors of the engines. The weight or spring of the governor of the alternator set which is required to give 80 amperes is adjusted for greater admission of steam, which tends to make it run faster than its partner. The two machines, however, being in parallel, one really cannot run before the other, but the alternator which is tending to turn fastest takes up load from the one that is lagging, until equilibrium is restored between the two. Also the current in the fields should be so regulated that, if the alternators were run separately with similar loads on them and at the same speed, they would require exactly the same current in the fields. This regulation of the fields is rather important, for if not attended to a large current may pass between the two alternators without doing any useful work.—John Pilling.

Answer No. 2.—The speed of the two alternators must be kept in the same relation the one to the other, in order that they may keep in step. An increase in the speed of one will cause it to lead in phase, and it will do more work, relieving the other of a portion of its load. This extra work on the one machine will check its speed, and the other one, being relieved, will be accelerated and thus the balance restored. To give each alternator a certain percentage of the total load, it is only necessary to adjust the governors to suit that percentage, as is done when paralleling the machines. The current given out by parallel alternators depends entirely upon the amount of steam admitted to their engines. By giving more steam to one engine its speed tends to increase, but is checked by the excess of work. Thus the speed being kept constant, the output must increase. Alternators when in parallel should have their loads adjusted, so as to be in an equal ratio to their maximum outputs.—T. A. Locke.

THE METROPOLITAN and Third Avenue roads have come closer together since the Tammany victory and there will now be only two conduit tracks on Amsterdam avenue, while the Third Avenue Company will be able to operate on the Kingsbridge Road.

DETROIT, MICH., after agitating for slow trolley cars, has come to the sensible opinion that it wants fast ones; and the slow speed ordinance gets its quietus.

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MAXIM'S THICK FILAMENT INCANDESCENT LAMP.

THE great impetus given to electrical distribution by the improvements of the last few years in generating apparatus of the alternating type, in which the two-phase and three-phase systems have played important parts, has brought incandescent lighting very close to gas in some cities. But we venture to say that no improvement could begin to approach in importance a radical departure in the incandescent lamp itself which would bring about a higher efficiency in that essential of the entire lighting system. Hence, one is bound to give due consideration, and full weight, to any proposed method or construction for increasing the lamp efficiency. Some months ago we commented on a cable dispatch from England, announcing a new lamp invented by Mr. Hiram S. Maxim. No details were given at that time, but now we have it from Mr. Maxim himself that his new lamp is one having a very high resistance with a short, thick filament. The substance of the "burner"—one can hardly call it a filament—is carbon and other materials.

In view of the encouraging details given by Mr. Maxim, as to the life of his new lamp, it may be worth while to consider the principles involved in the construction of such a lamp. The dimensions of any filament, of course, depend entirely upon the voltage and candle-power, and the specific resistance of the material. Hence, the higher the resistance of the material, the shorter and thicker the filament must be. Within reasonable limits there is very little difference in the performance of a thick and a thin filament, but what difference there is favors the thick filament. But the quality of the lamp and its ability to be burned at a high efficiency depend almost entirely upon the stability of the substance of the filament at a very high temperature. Up to the present time no commercial lamp has been produced, having a filament made of any other material than carbon, which seems by nature to be adapted for use in incandescent lamps. Mr. Maxim, as noted above, uses carbon in combination with other materials. In the absence of definite details as the composition of the new Maxim "filament" it would be of little profit to speculate at length on its nature. It may be worth while to point out, however, that there are metals which have a reputed melting point higher than the temperature at which carbon filaments are used; but as metals are of very low specific resistance, filaments made from them would of necessity be very long and thin, if used at ordinary voltages. It must not be forgotten that there are many substances which will stand a higher temperature than that at which the carbon filament is now operated, but the trouble has always been to get substances which had the additional, necessary qualities of being a good conductor of electricity and adaptability of being made into the required form for filaments. Of course, it is conceivable that by making a sufficient number of experiments, such a combination of materials as would give the conducting and temperature-resisting qualities could be produced, but, so far, these experiments have been unsuccessful.

We believe we are violating no confidence when we state that Mr. Edison—who, as every one knows is an indefatigable experimenter, and who believes in trying everything—in his efforts to find a fluorescent substance for his fluorescent screen work, has made experiments extending over nearly two years, in which he has made mixtures of pretty well every substance known to science, in almost every possible proportion, with the aim of producing a better filament than the straight carbon filament. He has failed so far to find such a substance. This, of course, does not prove the impossibility of finding one, but it will, nevertheless, serve as an index of the work which has been done on the subject by one whose inventive resources are practically unlimited.

If Mr. Maxim has succeeded in finding such a material and producing a practical lamp it will be hailed with delight by the entire electric lighting fraternity and he will be congratulated on his success.

WOOD AS FUEL IN LIGHTING STATIONS.

WE have heard surprised comment once or twice lately over the fact that some central stations in this country burn wood. Why they should not do so, if it is cheap and suits their purpose, we fail to see. There are probably twenty or thirty such stations, while of isolated plants burning up wood and lumber refuse there must be a good many. Regret has been expressed, in the same way, at the consumption of corn in locomotives sometimes out West; but it would be hard to prove that anyone had ever died of starvation because the farmer thus got rid of the superabundance that was choking his barns and bankrupting him in providing storage capacity. It seems to us no more wrong to burn corn than to burn coal, both being provisions made for man by nature; and man must keep warm and drive his machinery.

The Edison plant at La Grange, Ore., in the summer months, with a ten hours run, and load of 50 h. p. electrical, uses two cords of seasoned fire wood, weighing about 3,000 pounds per cord, and costing $2.50 per cord. The company has a common wood burning grate set 18 inches from the boiler and 6 inches below the door; dead sheeted about two feet on the sides and back. The La Crosse Brush Co. uses pine and hemlock slabs and strips or "edgings" from the local saw mills. The edgings are mostly used and are cut in 4 feet lengths, tied in bundles convenient for handling, say 50 or 60 bundles to the cord; and at a cost, delivered, of $1.50 to $1.75 per cord. This plant is also in the sawing season fed with shingle sawdust and planer shavings mixed in about equal portions and fired by hand with wide forks. The cost for this is a little less than that for cord wood. Ordinary wood grates are used. At Willow Springs, Mo., the electric light and water works, a private property, is using about 1¼ cords per day, of 4 foot cord wood, the cost being $1.25 per cord delivered at the power house.

Electrical plants are obviously good media for the consumption of debris and waste, and the wonder is that more refuse is not thus disposed of. Cord wood will not always be so handy and cheap, but shavings and sawdust will always be with us; and it will have been noted that one of the reasons given for the success of the Shoreditch destructors, in London, is that they get the scrap heaps from the makers and users of packing cases.

ELECTRICITY DIRECT FROM COAL.

HOW long the reign of the dynamo as an electric current generator will continue may be a matter of speculation, but that it will cease some day is no longer a matter of doubt to those who have followed the work being done in various directions. We know, as a matter of fact, that some of the ablest experimenters are devoting much of their time to this problem, and each man's work brings us a step nearer to the desired goal. Many have been the lines on which it has been sought to obtain current from the oxidation of carbon, but though the problem is exceedingly simple when reduced to its ultimate elements, practical difficulties of a formidable nature present themselves. It is not necessary to specify these—the fact that no carbon consuming electric generator is yet practically available is sufficient testimony on that point. The most recent attempt to give us the great desideratum is that of Prof. Short, whose apparatus is described elsewhere in this issue. Prof. Short has, we believe, started out on the correct principle, namely of utilizing carbon in the shape of coal just as it comes from the mine, leaving the process itself to take care of preparing the carbon in a manner suitable for its disposition in the electric generator. We consider this a most

important and far reaching step in advance, for however promising in other respects a process may be in which the carbon or coal requires to be prepared for use, the cost of that preparation will always militate against commercial success. As yet we have no figures before us upon which to base the economy of Prof. Short's method, but the generation of gas as a by-product will serve to give his invention an additional value, enabling electric generating plants to distribute gas as fuel. Perhaps some of our gas friends might look upon the scheme as a case of the tail wagging the dog, and might consider the electric current as the by-product. That is a matter about which we need not worry. If the electrical end is all right, electrical engineers will not haggle over terms of definition.

THE PADERNO TRANSMISSION PLANT.

ITALY has from the very start lent a favorable ear to the electrical engineer, and its Milan Edison plant, installed by Mr. John W. Lieb nearly fifteen years ago, was among the first incandescent central stations erected in the world. Indeed, if we are not mistaken, some of the old Edison "Jumbo" generators are still grinding out current as of yore at Milan. It was at the Turin Exhibition, in 1884, that Gaulard & Gibbs secured a well merited prize for their transformer system of distribution, and although the form of converter there shown at work has been abandoned for the more modern type, the electrical historian of the future will not fail to accord to these inventors a niche in the electrical temple of fame. The numerous water powers of Italy have long been an alluring bait for the electrical engineer and several of these, among them that of Tivoli have already been utilized successfully. The latest transmission plant in Italy is that located near Paderno, where the rapids of the River Adda make available several thousand horse-power. The numerous interesting features of this plant are illustrated in this issue and may, perhaps, afford points for American engineers engaged in similar work.

ELECTRICITY ON THE MANHATTAN ELEVATED.

THE recent election in New York City may by its results have considerable influence on electric traction work. It is said that the incoming party will block as far as possible for the present work on the proposed underground road, and will lend its aid rather to the Metropolitan Traction Company and the Manhattan Elevated road. The former is now busily gridironing the streets for its new underrunning trolley system, which is beginning to yield such good results; and now the latter comes forward with several new plans, one of which is alleged to be the early adoption of electricity. Some time ago, we pointed out how the Elevated could equip its system and yet save or make money, and Mr. George Gould is quoted as using among his friends some figures practically identical with our own calculations. This is as it may be. When the Elevated adopts electricity we shall believe it, but not before that time. It would certainly be very interesting to see what plans the company adopted when the moment arrived for the change. We have heard recently that rather than put in a big power station to begin with, the company might try a number of individual gas engine plants driving generators for their respective sections of the track and road.

ELECTRIC LOCOMOTIVES IN TUNNELS.

IT is reported that three Grand Trunk trainmen were suffocated a few days ago in the Port Huron tunnel, by coal gas generated by the steam locomotives still in use there. It would seem that at this late day, in such places as that tunnel, or the New York Central tunnel in this city, or the Metropolitan underground road in London, resort would be promptly made to electric traction. There are various ways of delivering current to the motors, any of which are easily applicable under the conditions, and the work done by the big locomotives at Baltimore, in the B. & O. tunnel there, is guarantee of the ability of electricity to do the heaviest work of that character. The gain in public comfort and convenience, as exhibited by the Boston subway under the Common is remarkable. Such occurrences as the Port Huron Grand Trunk accident are a decided anachronism.

SOCIETY & CLUB NOTES

CHICAGO ELECTRICAL ASSOCIATION ON HEAVY ELECTRIC TRACTION.

THE meeting of the Chicago Electrical Association, at 1737 Monadnock Building, the evening of December 3, was taken up by a discussion of "Heavy Electric Traction," the paper of the evening on that subject being by Mr. Lloyd Marshall, electrical editor of the "Street Railway Review." Mr. Marshall reviewed briefly the increase in number of electric roads operating under conditions approximating steam railway practice and gave an informal talk on the new Sprague system of multiple unit electric trains to be used on the South Side Elevated Railroad in Chicago. One of these trains is now being tried in regular service on the Metropolitan Elevated. Mr. Marshall explained the advantages of the multiple unit system in the way of its possibilities of rapid train acceleration during hours of heavy traffic at the time the accelerating power of a locomotive or motor car at the head of the train is at its worst. He then told of some of the details of the apparatus by which the controllers on each car of a train are operated by a pilot motor circuit from the first car. After taking up the Sprague system he enlarged on the features of electric traction which recommended it to heavy work, such as rapid train acceleration due to steady torque on the driving wheels, cleanliness, ability to put unlimited power in one locomotive owing to the source of power being external and the possibility of generating power cheaply at a central station. He stated the cost of power in eight large electric railway plants in this country, for which he had the figures, averaged \$.00885 per kilowatt hour. The transmission of power by alternating currents for railway use was next taken up and its advantages enlarged upon. He expressed great faith in the ultimate use of an alternating motor for railway work.

In discussion of the paper J. R. Cravath made the further explanation in regard to the Sprague system that one of its great advantages lay in the fact that with it trains of greater length could be run than any permissible elevated locomotive would haul, and thus the capacity of the road increased where the number of trains was already such that the number could not be increased without having trains interfere with each other. He also maintained there was little to expect in the way of alternating current transmission from steam plants for railway purposes until an alternating railway motor was forthcoming, because at present the enormous investment in transformers and line made it cheaper to build a steam plant rather than establish sub-stations. Mr. W. A. Harding also indorsed this view, telling of some calculations made for an interurban road which confirmed the statement.

After the meeting some time was spent in social intercourse and an exchange of ideas.

The next meeting will be held December 17, when Mr. C. C. Mattison, of the Chicago Shipbuilding Company, will give a paper on "Electricity in Shipbuilding."

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS held last week, in this city, one of their most successful general meetings. A large number of good papers were presented and discussed, and the attendance was excellent.

OBITUARY

GEORGE R. BLODGETT.

George R. Blodgett, patent counsel for the General Electric Co. and one of the best known patent lawyers in the country, was shot early on the morning of December 3 by a burglar and has since died. The crime was committed at Mr. Blodgett's residence, 11 Front street, Schenectady. Mr. Blodgett unarmed made an effort to catch the burglar and was shot in the struggle. Two men are believed to have been engaged in the attempt at burglary. Mr. Blodgett was thirty-five years of age, and a native of Maine. He practiced law in Boston before entering the General Electric Company's corps of counsel. The General Electric Company has offered a reward of \$5,000 for the capture of the murderer.

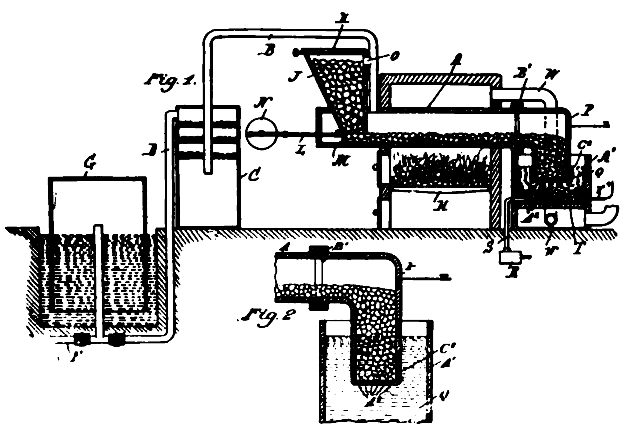
MISCELLANEOUS

PROF. SHORT'S COMBINED GAS AND CARBON ELECTRIC GENERATOR.

AMONG those who have devoted attention to the problem of generating electricity direct from coal or carbon is Prof. S. H. Short, of Cleveland, to whom a patent has just been issued on a highly interesting method of this nature and in which he combines a method of generating gas at the same time.

We may premise that some time back Prof. Short filed in the U. S. Patent Office a description of a method for generating electricity, a process wherein carbon, coal, or carbonaceous material is subjected to the action of an electrolyte which is capable of receiving oxygen and transferring the same electrochemically to the carbonaceous material to effect an oxidation thereof, such action resulting in the generation of an elecric current. Later Prof. Short recognized that this method of electric generation may be most economically and efficiently carried into practical commercial effect in conjunction with a gas-generating plant, and this conception forms the basis for the present apparatus.

In the accompanying diagrams, Fig. 1 shows a form of apparatus adapted for the purposes above mentioned. Fig. 2 is an enlarged sectional view of the cokeholder. In the diagrams A designates a gas-retort adapted to receive the coal, and wherein the latter is baked to evolve therefrom the gases, which pass off in the usual manner in gas plants through a connection B to a purifier C, of the usual construction, thence through



FIGS. 1 AND 2.—SHORT'S COMBINED ELECTRIC AND GAS GENERATOR.

connection D to the service main F or to the reservoir G, or to both, in the usual manner.

H designates the furnace for supplying the requisite heat for baking the coal, which is introduced into the retort A. The coal is introduced into the retort A. The hopper J is adapted to receive the coal previous to its being fed into the retort, the hopper opening at its lower end into the retort and provided with a cover K at the top, which cover is made removable, but which is gas-tight when secured in its closed position. A plunger L, having a pusher end M, is arranged to travel adjacent to the lower end of the hopper J, and when actuated is adapted to feed or push the coal into the retort. The plunger L is actuated by means of a crank connection with a disk N, which is rotated.

In his previous device Prof. Short employed the process of generating electricity by subjecting the carbon to the electrochemical action of an electrolyte capable of receiving oxygen and of transferring the same to the carbon to effect an oxidation thereof is best effected under the influence of heat, the electrolyte being maintained, preferably, in a molten condition, and better results being obtained when the apparatus is heated. In the present apparatus, therefore, he arranges the carbon-holder P, which forms the positive element of the cell, but the negative pole of the couple, adjacent to and in connection with the gas-retort A, and at the farther end with reference to the hopper J, in order that the residue from the gas-retort, after all the gas for illuminating or other purposes has been baked out of the original coal, thereby leaving the same in the form of coke, may be pushed by the plunger L and its plunger-rod M and the fresh coal from the retort into the carbon-holder of the electric generating plant while still in its heated condition, it being understood that when the carbon is maintained in a heated condition the nascent oxygen of the electrolyte or resulting from the electrochemical action of the electrolyte will attack the carbon more vigorously and freely, and hence result in a more efficient electric generation. Therefore in the present apparatus as fast as new coal is supplied to the gas-retort to produce illuminating or heating gas the previously exhausted—that is, the coke product, which the new or fresh coal replaces—is fed into the electric generating apparatus or carbon-holder P while still in its heated condition, and is therefore consumed or oxidized in the process of electric generation, by the electrochemical action of the electrolyte Q.

The carbon-holder P should be of suitable conducting material and of such a nature as not to be acted upon by the electrolyte. Prof. Short has found iron to be a suitable material for this purpose, and the holder P should be so constructed as to permit the electrolyte to gain access to the carbon contained therein. This can be effected by perforating the bottom of the holder. The necessary oxygen which is required to effect an oxidation of the carbon or coke in the holder P is supplied to the electrolyte in any convenient manner. In the form of apparatus shown an air pump R is provided for forcing a current of air through connection S into the negative element T of the cell, and from which, through electrochemical action, the oxygen is transferred through the electrolyte Q to the coke contained in the holder P, where it attacks and oxidizes the coke, the products of oxidation passing off in the form of gases, and the result of the oxidation is the production of a current of electricity, the positive pole of the couple being connected electrically to the negative element T, as indicated at V.

The negative element, T, is composed of an oxidized or oxidizable material, such, for instance, as lead. A convenient method of maintaining the negative element, T, of the cell and the electrolyte Q and the coke contained in the holder P at the required degree of temperature to secure the best possible results, and in the most efficient and economical manner, the products of combustion from the furnace H, after performing the work of baking the coal in retort A, pass through connection W to the vessel A', into which the negative element of the cell and the electrolyte Q are contained, and maintains the same at the required degree of temperature.

The coke-holder is of conducting material, such as iron, and the electrolyte gains access to the coke contained in the holder through suitable perforations (indicated at A^2) in the bottom thereof, or as shown in Figs. 1 and 2; the bottom part of the holder may comprise the portion C^2 of porous material, through which the electrolyte may pass.

It will be understood that the coke-holder P of the electric generation plant is insulated, as indicated at B', from the gas-retort A, in order to prevent short-circuiting of the current generated.

From the foregoing description it will be seen that Prof. Short combines a gas generating plant with an electric generating plant, thus reducing the cost of electric generation to the lowest possible point by utilizing the coke while in its heated condition for the electric generation and by utilizing the heat products required for the gas generation to maintain the electric generation cell at the required degree of temperature for the most effective results.

MAGNETISM AND ELECTROLYTIC CONDUCTIVITY.

Some thirteen years ago Neesen announced that a strong magnetic field is capable of modifying the conductivity of a solution of ferric chloride. If true, this effect would be of paramount importance to the theory of electric conduction. But, according to G. Milani, it is not true. He used for his experiments a U-tube, carrying the liquid, and provided with side tubes, through which a pair of unpolarizable electrodes were introduced. The latter formed the terminals of a very sensitive capillary electrometer, and consisted of the capillary ends of siphon tubes leading into bottles containing saturated $ZnSO_4$ solution and a rod of amalgamated zinc. The magnetic field was generated by a large horseshoe magnet 1.2mm. long. Alterations of temperature were precluded by the rapidity of the measurements. The dimensions of the tubes, the concentration of the solution, the currents and magnetic fields were varied in every possible manner. A difference of resistance of about ½ per cent. was apparently produced, but this was almost entirely suppressed by a perfect insulation of the electrometer wires. Neesen's effect, therefore, either does not exist, or it is so small that its existence cannot at present be demonstrated.

SAFE CURRENT CAPACITY FOR ELECTRICAL CONDUCTORS.[1]—I.

BY C. H. SEWALL.

THE proper amount of metal in an electric conductor sufficient to transfer a given energy is governed by "loss" and "carrying capacity."

Any conductor offers a resistance to the passage of current causing a certain loss in energy which passes from it in the form of radiated heat. The resistance offered is directly proportional to length and inversely so to cross-sectional area. A long conductor has large radiating surface in proportion to the amount of current developed, and, consequently, in a connection between two points a considerable distance apart, the limit of economy in loss is generally reached without undue heating. On the other hand, a short conductor, by reason of its low resistance, will cause a heavier current to flow, and, owing to the small extent of surface exposed for radiation, may develop a temperature dangerous to its surroundings, while the loss in energy still remains within proper bounds.

In the common acceptance of the term "carrying capacity" means "safe current capacity"—that is, the current which may be carried without danger for a given cross-section.

The "carrying capacity" of a conductor is expressed by the number of amperes of electric current it will transmit without exhibiting more than a specified increase in temperature above that of its surrounding medium; and it is "safe" when that specified increase is safely limited.

To determine the proper limit is the undisputed prerogative of fire insurance companies. These companies have formed associations for mutual protection. The culmination of organization is the National Board of Fire Underwriters. This board issues a code of rules which must be observed by any property owner who desires to be insured by any of the companies in the associations. Municipal ordinances have been made in conformity with insurance rules, so that both the insured and the uninsured (if the latter exist) are bound by them.

Recently delegates from nine different bodies have united in framing what is called the National Electrical Code for government of the installation of electric wires and apparatus. It has been adopted by municipal authorities generallly, and is now, for all practical purposes, as much the law of the land as if it had been decreed by State of national legislature.

So far as the code relates to "carrying capacity" of conductors it prescribes, in a table, a maximum number of amperes that can be sent through wries made from pure copper of 98 per cent. conductivity for three different conditions and covering a range from No. 18 B. and S. gauge to 2,000,000 circular mils.

Here is a tabulated abstract from the National Code:

Cir. Mils.	Amp. Rubber-Covered.	Amperes W. P. Wires.	Amp. Marine Work.
2,000,000	1,050	1,670	...
1,000,000	650	1,000	...
500,000	390	590	...
413,639	...	...	340
250,529	...	...	235
B. & S. G.:			
0000	210	312	...
0	127	185	...
6	46	65	...
14	12	16	12
18	3	5	3

It is the purpose of this paper briefly to discuss the general physical laws and conditions which bear upon the subject.

One of the old rules for determining safe current capacity was that of Clark, Ford & Co., English wire manufacturers. It allowed 10 pounds of copper per mile for each ampere of current. Translated into familiar terms this means that No. 18 B. & S. carries 2½ amperes; No. 6, 42 amperes, and No. 0000, 338 amperes. I will put them opposite the figures of National Code for same sizes:

Cir. Mils.	R. C. Wires.	C. F. & Co.	W. P. Wires.
0000	210	(338)	312
6	46	(42)	65
18	3	(2½)	5

Taking averages for all conditions this ancient rule of thumb is not so far out of the way for those sizes with which the early manufacturers were familiar.

Subsequently the British Board of Trade established the rule of 1,000 amperes per square inch of cross-section. Here is the comparison with the code:

Cir. Mils.	R. C. Wires.	B. T.	W. P. Wires.
2,000,000	1,050	(1,570)	1,670
1,000,000	550	(785)	1,000
4/0	210	(166)	312
1/0	127	(83)	185
6	46	(21)	65
14	12	(3¼)	16

In March, 1884, Prof. George Forbes read a paper before the London Institution of Electrical Engineers, in which he exhibited mathematical calculations showing the number of amperes necessary to raise wires of given diameters to certain temperatures and also calculations as to the effect of insulated coverings. He pointed out that the Board of Trade rule, 1,000 amperes per square inch, was uneconomical for small conductors; and actually unsafe for those of large, though perhaps unusual diameters.

Mr. A. E. Kennelly read before the Edison Convention at Niagara Falls in August, 1889, a description of a series of experiments furnishing a great amount of reliable information. He did not, however, make experiments nor calculate tables upon the stranded conductors that are generally used when larger than No. 0000 B. & S. is required; and as the conditions in stranded conductors are quite different from those in solid ones, there was still uncertainty as to the proper current for large leads.

In November, 1896, Mr. Merrill, electrician for the Chicago Board of Fire Underwriters, made experiments in a station of the Chicago Edison Company, the results of which were issued in his laboratory report, No. 523, and are now published (with unimportant differences) as part of the code.

The maximum temperature to which a conductor may be raised must be limited by several considerations.

1. Heat increases the resistance of conductors. 2. Heat decreases the resistance of dielectrics. 3. Some kinds of dielectrics, notably rubber, will soften at high temperatures and permit the metal to sink into them, bringing it nearer the surface of, or possibly quite through, the insulating covering. 4. The temperature may rise to such an extreme as to cause a conflagration.

In 1888 a committee of the London Institution of Electrical Engineers reported the following rule: "The conductivity and sectional area of any conductor should be so proportioned to the work it has to do that if twice the current proposed be sent through it the temperature of such conductor shall not exceed 150 degs. F."

If 150 degs. F. is the maximum limit it is hardly possible to better the rule. It is supposable that no one will object to a factor of safety of two. The writer knows of one instance where, under very careful experimental conditions, a fuse that had been long in service successfully resisted current of twice its rated capacity.

As a starting point Mr. Kennelly thought that 75 degs. F. represented a fair average condition and his experiments are built up from that point. It was assumed that the temperature would increase as the square of the current strength. That being the case, a current sufficient to increase the temperature 18 degs. F. (to 93 degs.) would, if doubled, raise it four times 18 degs., or to 147; and just within the committee's danger line.

As Mr. Kennelly's figure for a No. 0000 insulated wire run in moulding is 175 amperes; and the new code gives 210, then the rise in temperature under the latter figure will be as (175) squared, or 30,625, is to (210) squared, or 46,200; and as the former rise was 18, the latter will be 28, and doubling the current, we shall have 112, or a maximum limit of 187 degs. But 75 degs. is not the maximum condition. It is conceivable that on a July day paneled wires may be surrounded by a medium showing 100 degs. F., and it seems fair to suppose that if double the current in amperes given in the present code should be sent through a wire in the condition indicated, its temperature will be raised to 212 degs.

[1]Read before the Chicago Elect. Assoc.

ELECTRICITY IN LION TAMING.

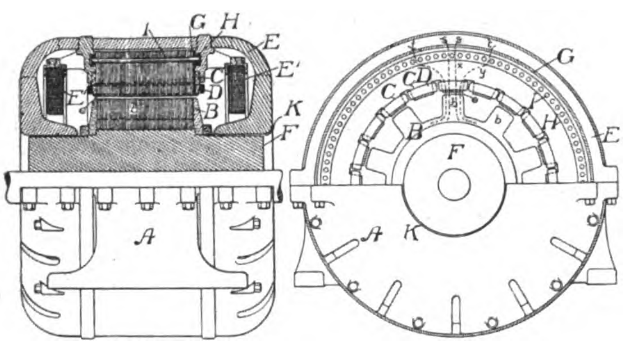
Pezon, the French lion tamer, has died at the age of 73. All the family are tamers of beasts. They try to minimize risks by all sorts of contrivances and educational terrorism in regard to the wild beasts. Electricity has served them in good stead at the taming rehearsals. Live wires were placed between them and their lions and tigers. When the tamer turned his or her back the wild creature advanced to make its spring, and received a shock that was a lesson for the rest of its life. Before electricity was much in use Pezon was nearly always obliged to keep his eye fixed on that of his lion. There was something in it that subdued the animal.

STEINMETZ'S INDUCTOR-DYNAMO DESIGN.

In inductor-dynamos the armature and field-magnet coils are stationary and the induction is produced by a change in the path of the magnetic flux effected by the teeth or poles of the rotating inductor. In consequence in part of the magnetic circuit the magnetism varies, and this part, to avoid eddy-currents, must be laminated, while in the other parts the magnetism is stationary and solid material may be used. It is, therefore, of importance to avoid changes in magnetism in the solid part of the structure in order to avoid excessive heating and loss from eddy-currents.

During the rotation of the inductor the length of the path of the lines of magnetic force, and thereby the reluctance, varies periodically in the laminated portion of the armature, which tends to make the magnetic density vary periodically also. To keep this periodic variation of magnetic density from extending into the solid part of the magnetic circuit, Mr. C. P. Steinmetz inserts an auxiliary air-gap between the solid and the laminated part of sufficient length to make the magnetic reluctance of the shortest and of the longest path across the armature-iron and auxiliary air-gap practically equal, and thus the magnetic density at the point of entrance into the solid part of the magnetic circuit practically uniform.

Another feature of Mr. Steinmetz's design consists in the use, in an inductor-dynamo, of a short-circuited or squirrel-cage winding surrounding the outer edge of the armature-iron. The magnetic reluctance of the air-gap between the inductor and the armature, especially in unitoothed single-phase machines, is less when the inductor-tooth stands in front of an armature-tooth than when it stands in front of a slot. Thus the magnetism in the latter case tends to decrease, and this induces eddy-currents in the whole magnetic structure. The use of the short-circuited winding tends to obviate this difficulty.



Figs. 1 and 2.—The Steinmetz Inductor Dynamo.

The accompanying engravings show a machine constructed according to these principles, it being applied to a dynamo of the well-known Thomson inductor alternator type; but it might equally well be applied to any other machine of the same general class. Fig. 1 is an end elevation, partly in section, of such a machine; and Fig. 2 is a side elevation, partly broken away for convenience of illustration.

In Fig. 1, A is the yoke or external portion of the armature-core. B is the inductor, consisting of the yoke F and the laminated teeth b b. C C are the armature-teeth, consisting, as is usual in such machines, of laminated iron, the yoke E being ordinarily made of cast-iron or mild steel. Surrounding the inductor and supported by the yoke are the field-magnet coils E' E', they being stationary.

G is the auxiliary air-gap above referred to, separating the laminated armature-iron from the yoke E. Between the yoke F of the inductor and the supporting-yoke E of the armature is the air-gap K, and the usual air-gap e is also located between the inductor and the armature.

The action of this part will be best understood from Fig. 2. The magnetic lines entering from the tooth b in the upper part of the figure and threading the coil spread out in both directions in the iron of the armature, reaching the yoke E at the point s in a practically straight line from the tooth and at the point t over the path y, which is curved and is considerably longer than the path x, having, therefore, higher magnetic reluctance. The magnetic density at s will be greater than at t. By the rotation of the inductor at the next moment the inductor-tooth b will stand in front of the next tooth of the armature, and the path to the point t will be approximately straight, while that to the point s will be curved, and thus higher density will exist at the point t than at the point s. To avoid these pulsations of magnetism in the yoke E is the object of the air-gap G. The reluctance of this gap being very large as compared with the reluctance of the armature-iron, as pointed out above, makes the total reluctance of the path y practically equal to the reluctance of the path x, and thereby insures practically an uniform distribution of magnetism in the yoke.

To assist the effect referred to, Mr. Steinmetz also provides a short-circuited squirrel-cage winding consisting of the copper pins I, Figs. 1 and 2, which pass through the iron of the armature near its outer edge and are connected upon each side of the iron by the short-circuiting bands H, also of low-resistance metal. Any pulsation or variation of the magnetic flux reaching the outside of the armature acts to induce secondary currents in this short-circuited winding. These currents tend to magnetize at the points of lower magnetic density and to demagnetize at the points of higher density, and thus cause a uniform distribution of the magnetic flux at the outer part of the armature—that is, when the flux enters the solid structure. The action of this winding is also beneficial in causing uniform distribution of magnetism and in preventing pulsation of the magnetism in the entire magnetic circuit due to the differences of reluctance in the main air-gap of the machine caused by the revolution of the inductor. As already pointed out, the reluctance is less when the inductor-teeth stand in front of the armature-teeth and greater when they stand in front of a slot, thus giving rise to changes in the distribution of the flux and inducing eddy-currents in the whole structure. It has been proposed to remedy this to some extent by winding the field-magnet coils E' upon a solid copper ring or spool. While thus useful, the construction indicated acts in a more efficient manner because it influences directly the armature-iron of the machine.

PHILADELPHIA GAS LEASE SIGNED.

The suits to prevent the city from leasing its gas works to the United Gas Improvement Company have been dismissed, and immediately afterward the contract was signed by Mayor Warwick. The lease is for a period of thirty years. Shortly after the decision became known the stock of the United Gas Improvement Company began to go up. From 87¼ at the opening the price rose to 91½ sales and closed 91½ bid. The par value is $50.

The lessees obtain control of a plant valued at $30,000,000, with the privilege of charging $1 a thousand feet for gas for lighting purposes.

MUNICIPAL LIGHTING PLANT TROUBLES AT WATERVLIET, N. Y.

Forty men, who defeated the proposition to expend $12,000 on the electric light plant, which was submitted to the taxpayers a few months since, must either wander about on dark streets evenings or stay out of Watervliet or at home. The shaft at the electric light station was the latest thing to break, and Watervliet has no electric lights. Repairs to the plant from time to time may sustain temporarily the city's lighting system, but sooner or later the crash will come, and several weeks or months will elapse before a new plant can be established. The Beacon Electric Light Company, of Lansingburgh, wants to provide light for Watervliet, and so do Troy parties. Watervliet's lighting has been inexpensive, but the present commission is tired of trying to light effectively without funds.

Leading citizens favor a new municipal plant. Other taxpayers, whom a representative of the Municipal Gas Company persuaded to vote against an appropriation, don't know where they're at. Legislation may be resorted to in order that the commission may have power to enlarge the plant and put in an incandescent system as well.—Albany Express.

HOW ALAMEDA, CAL., FIGURES ITS LIGHT.

In accordance with the request of the Board of Trustees the city clerk of Alameda has presented a report showing the actual running expenses of the city's municipal light plant, together with a statement of what the city lights would have cost had they been bought from a private company. For the four years that the plant has been owned by the city the expense for salaries has been $19,255.15; supplies, $20,820.88; repairs, $1,032.06; sundries, $2,497.20; making a total outlay of

$43,805.29. The receipts from private users of electricity have been $7,733.29, leaving a balance of $36,071.38 as the actual net cost of the city's street and other lights for the four years, or an average of $751.49 per month. At the same rates charged by a private company to the city of Oakland for the same service, the number of lights used on the streets and in the various public institutions of this city would cost a total of $50,-252.40, or an average of $1,046.94 a month, making a total saving to the city of $295.45 per month. The Alameda statement leaves out, however, several items of expense which, if figured in, would change the saving into a dead loss.

COLUMBUS, O., is to try a municipal plant, wit.. a capacity of 500 lights of 2,000 c. p. or 625 o. 1,200, and will probably start in with an expenditure of $68,000. It has the usual low estimates of cost of operation.

KANSAS CITY, MO., has a plan before it of a construction company to build a municipal plant, mortgage it and sell the equity to the city, so as to avoid the constitutional limitations to the power of the city in contracting debt. The estimate for a plant is $100,000.

ELECTRIC TRANSPORTATION

NEW MOTOR CAR EQUIPMENT FOR METROPOLITAN ELEVATED, CHICAGO.

THE recent opening of the Union Elevated loop, giving all the elevated roads of Chicago an opportunity to land passengers within a short distance of any point in the down-town district, resulted in a large increase in the elevated traffic, that on the Metropolitan being about 50 per cent. This necessitated an increase in the rolling stock and it became a perplexing problem, in view of all the conditions, how best to do this. The road is at present equipped with motor cars having two G. E. 2,000 motors mounted on one truck, the other truck being free. With these motors two and three trail cars are hauled during the rush hours. The original plan was to add two motors exactly like the ones already in use, to each motor car, as soon as traffic demanded the pulling of four and five trailers, thus putting a motor on each motor car axle. Experience has demonstrated, however, that the present motors, which have a maximum speed of 38 to 42 miles an hour are too fast for the best service on this road, and that, with the loads they have to pull, an excessive current is required to get them up to speed in the short distance between the stations. To successfully operate up to such a high maximum speed between such frequent stops would require a large power plant capacity and larger motors, built to stand without injury the heavy current necessary to accelerate the trains in such a short space to such a high speed. This was something that was difficult to foresee at the time the road was built. It was impossible to put on a lower speed gearing, so the practice has been to operate the motors in series at a maximum speed of about 20 miles an hour for the greater part of the time and to throw into multiple only when crowded for time and between the stations the farthest distance apart. This has given a fairly satisfactory service, but, of course, it is desirable to have motors of a low enough speed so that they can be thrown into multiple regularly between every station, thus getting the full benefit of the economy of series-parallel control and allowing a somewhat higher maximum speed than can be made with the present motors in series, viz., a maximum of 28 to 30 miles an hour. Mr. W. E. Baker, superintendent for the receiver of the road, and his staff, had a very trying problem to solve as to how to add to the motor equipment without purchasing more motors of a speed that experience has proved to be undesirable, as would be necessary were the original idea to be carried out. A very satisfactory way out of the difficulty has been found, however, and Mr. Baker is to be congratulated on the promptness with which it has been done.

The present motors will be removed from half of the present motor cars and placed on the unoccupied trucks under the other half of the motor car equipment. There will then be 28 motor cars equipped with four motors each. Instead of running the motors on these 4-motor cars in multiple for full speed they will be run two in series, two in multiple, so that each motor gets 250 volts. Of course, they will be grouped all four in series to start. To secure the desired maximum speed of 28 miles an hour from these motors (which are now geared to run about 20 at 250 volts) it will be necessary to change the gears, which however is easily done and the equipment will no doubt be a very satisfactory one.

The remaining 28 of the motor cars from which the present motors are to be removed will be equipped each with two motors of heavier design than the G. E. 2,000. To accommodate the new motors, the Baldwin Locomotive Works will furnish a new truck designed by the Metropolitan Elevated. The new motors will be partly General Electric and partly other makes. The specifications call for ample ventilation through the motor case with opportunities of closing the case if desired.

AN ELECTRIC TRAMWAY DE LUXE IN BELGIUM.

In an article on the Brussels Exhibition which appeared in the October number of the "Railway World" (London), the following short description of the Tervuren Tramway occurs: "The Tervuren Exhibition may be said to begin with the electric tramway by which it is reached. The scenery all along the line is most interesting; and there are a variety of curves and gradients, down which the cars travel for long distances with the current shut off. The speed at times is very high, and the sensation experienced when traveling on the front platform must resemble that of flight, for the motors make surprisingly little noise, and the cars ride with great ease. Some forty motor cars are employed on the line, and they are equipped with two 25 h. p. Walker motors and controllers, which are said to give excellent results. The generating station is also equipped with Walker dynamos, the total capacity being about 150 k. w. Ornamental side poles with short arms carry the trolley wires, but as the trees along the boulevard grow these will be almost entirely concealed. The whole installation affords a fine example of the combination of tramway and light railway methods. The last line was only opened on the 10th of May last, and there are already evidences of the increase in estate values along the line. In fact, the district will probably become one of the finest residential quarters of Brussels, as the tramway furnishes such comfortable and rapid means of communication with the center of the city. On one of the services which traverse the route buffet cars are attached to the motor cars, and light refreshments can be obtained en route."

This is certainly an innovation in electric tramway service and is probably the first instance of a dining car on an electrically driven train.

A CHICAGO SUBURBAN LINE.

The Chicago General Electric Railway Company, it is said, will avoid the necessity of complying with the street railway ordinances of Chicago, by placing itself under the protecting wing of the Interstate Commerce Commission, giving it all the rights and privileges of a steam railroad. To accomplish this it proposes to run its cars into the State of Indiana, making Hammond its terminus, and becoming a common carrier. The road will reach the Indiana town over leased lines. This arrangement will be the first time that a street railroad has taken advantage of the Allen bill, which grants the right to lease lines.

LITERATURE

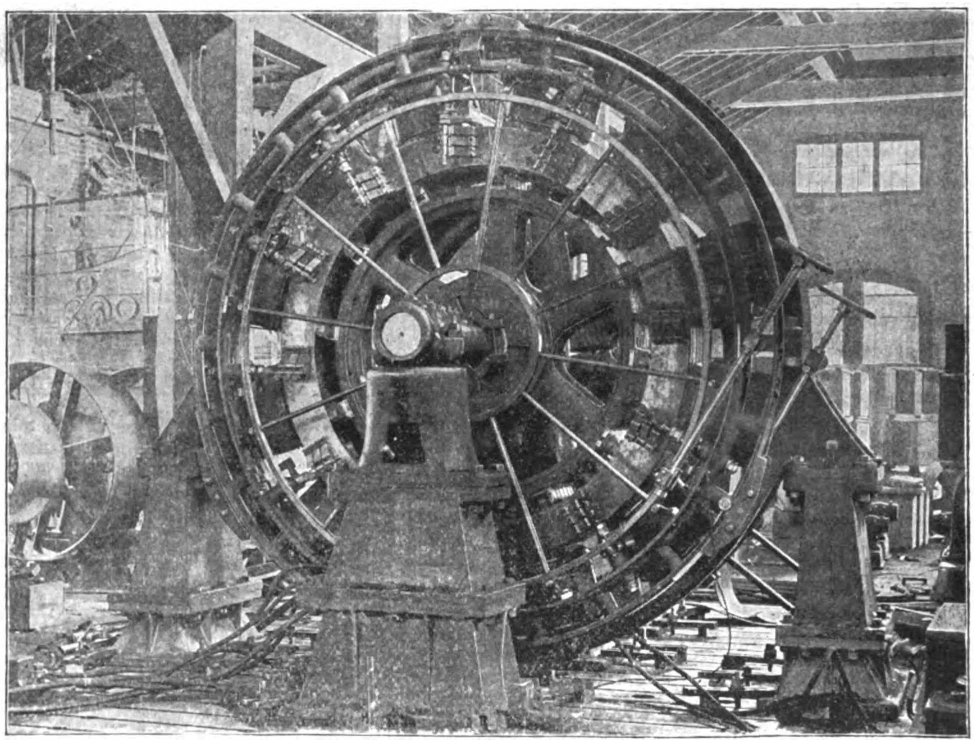
THE AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC for 1898 contains over 400 pages and 300 illustrations. (Published by the Scovill & Adams Co., 60-62 East 11th street, New York. Cloth and paper.)

Some magnificent specimens of half tone work and color printing are shown, while the reading matter is unusually interesting. The table of contents reads like a photographic library, while the list of authors comprises the names of the best known authorities in the art of photography. Twelve pages of supplement are devoted to novelties marketed by various dealers; eighty pages contain standard formulæ, tables, etc.; a catalogue of good books is given, with a vast amount of miscellaneous information, including the laws of patents, a list of photographic patents issued during the past year, postal information, the names and addresses of photographic associations in America and foreign countries, and a list of United States hotels maintaining dark rooms. The Annual is a valuable production and should be in the library of amateur and professional alike.

ELECTRIC LIGHTING

ADDITIONS TO THE PATERSON, N. J., EDISON CENTRAL STATION PLANT.

AN addition to the lighting portion of the station of the Edison Electric Illuminating Company, of Paterson, N. J., will shortly be made in the shape of two 200 k. w. ten pole 150 revolution smooth body General Electric lighting generators. These will furnish current to their already extensive three-wire system, and when installed will give to the Paterson Company a total generating capacity for lighting purposes of 1,400 k. w. in direct connected apparatus of the General Electric smooth body type. The feature of these machines which has given them their name lies in the armature, which is built up of a laminated soft steel core without teeth, having the coils in the shape of rod, or pressed, stranded conductors connected by end bars forming the surface of the commutator, which is on the vertical face of the armature and has, of course, as many segments as the armature has coils. The adoption of this method of construction saves losses due to resistance in commutator leads and segments and is of importance in generators of low potential with large current output. The large number of segments reduces the volts per bar to a minimum, and renders them absolutely sparkless, while the vertical commutator permits of the inspection of all the brushes at once. The brush holders are so arranged that by one hand wheel they may be simultaneously shifted or by another all raised at one time from the face of the commutator.



General Electric M. P. 12-400-120 with Smooth Body Armature for Paterson, N. J.

GREAT LIGHTS ALONG COAST ARE OBJECTIONABLE.

A special dispatch from Washington of recent date says: The plan to establish at Barnegat the greatelectric light purchased from France at the Chicago World's Fair is now being tested at Tompkinsville, Staten Island, and will probably be abandoned by the Lighthouse Board, in deference to the opinion of experienced mariners. Such lights have been in practical use on the north and west coasts of France and Germany for several years and it was thought that the installation of one on the New Jersey shore would prove of great advantage in bad weather to both transatlantic and coastwise vessels bound for New York which were deterred from approaching too near Sandy Hook in heavy gales and storms. It is known that the great light which the Lighthouse establishment owns would give warning of its presence at least fifty miles out at sea, while the present apparatus at Barnegat is visible only nineteen nautical miles, and that at Navesink only twenty-one miles, the greatest radius of visibility of all lights on the coast.

The Gironde River entrance light on the west coast of France is clearly seen twenty-one miles, but its "luminous range of visibility" is fifty-six miles, and a little further north the Belle Isle light has a luminous range of fifty-four miles, its intensity varying according to atmospheric conditions. A similar light near Cherbourg, directly visible for twenty-two miles, has a luminous range of fifty miles, and there are several others of like power along the Channel.

Captain R. D. Evans, who commanded the New York at the Kiel review, taking that vessel on a considerable cruise through Northern European waters, had experience with these great lights, and now, as a member of the Lighthouse Board, he will probably prevent their adoption in this country. He says that instead of assisting mariners they contribute to the dangers of navigation. He says the object of a light is to warn navigators of its exact location, in order that it may be avoided, and to display its characteristic features so that its individuality may be definitely known, thereby enabling a pilot, after seeing it, to set his course true. The great French lights in all bad weather utterly fail in these essentials. Their extreme visibility depends on the reflection of their great intensity from the sky, the lantern itself being below the horizon. At times when the New York was going placidly along on a safe course, at night, overhanging clouds would catch the reflection of one of these lights and startle every one on the ship. It was impossible to tell the direction of the source of illumination, or whether it was fifty or ten miles away, and for all any one knew it might have been a searchlight signal from a ship dead ahead or astern.

The reflection of the Cherbourg light has been noticed nearly seventy-five miles at sea, without giving a clew to its direction. His investigations and those of other members of the Board have led to the practical conclusion not to put the big light at Barnegat at present, though it might be utilized at some other point.

TOPEKA, KAN.—The Atchison, Topeka & Santa Fe Railway is actively equipping its cars with electric lighting from the axle, with storage cells.

CLEVELAND, O.—The steam roads are trying to prevent the carrying of freight by the interurban trolley lines.

LEGAL NOTES

ALLEGED TELEPHONE FRAUD IN BALTIMORE, MD.

A special dispatch of November 30 from Baltimore says: The Grand Jury found presentments against F. B. Hubbell, William J. Atkinson, and James Russell, president, secretary, and treasurer of the Best Telephone Company of this city, charging them with having made false reports of the financial condition of the concern, with intent to deceive. The prosecuting witnesses are all members of the Baltimore Stock Exchange.

According to the story told before the Grand Jury, Atkinson caused to be made to the Stock Exchange a sworn statement signed by President Hubbell and Treasurer Russell of the Best Telephone Company, that the corporation had assets of about $2,500,000. This was done, it is alleged, for the purpose of inducing the exchange to list the company's stock.

The Stock Exchange refused to list the stock, the creditors of the telephone company became pressing, and Mr. Atkinson had the concern placed in the hands of receivers. The receivers found that the assets of the company were worth not more than $12,000 or $15,000, instead of $2,500,000.

NEWARK, N. J.—Judge M. C. Carter, in the First District Court, has sustained the "vestibule" law and approved the fine of the Consolidated Traction Company of $25 for not having vestibules on its winter cars for the protection of the motormen. Five other similar cases are to be decided.

REPORTS OF COMPANIES

ELECTRICAL MANUFACTURING CONSOLIDATION ON THE PACIFIC COAST.

Leading electrical manufacturing companies of the coast have united for the formation of a construction company and articles of incorporation of the new concern have been filed in San Francisco and Sacramento. It will be known as the Finance and Construction Company, and has a capital stock of $500,000. The shares will be divided between the various electrical machine manufacturing concerns, and each will have equal representation in the Board of Directors, which will be composed as follows: C. S. Young, president and manager; J. A. Lighthipe, vice-president; George P. Low, secretary; C. E. Dutcher, superintendent of construction, and John Martin. Colonel E. F. Preston will be the attorney.

The reason for the formation of the Finance and Construction Company, whose principal object will be the installation of electric machinery, is that the manufacture of the machinery and its installation are quite foreign to each other. Each of the manufacturing concerns has been forced into construction by circumstances. They have been compelled to employ skilled and high-priced labor for installation, at a loss, as none of them has sufficient work to keep its men engaged all of the time. They therefore decided to unite their forces on this branch of the electrical business. The first operations of the Finance and Construction Company will be the installation of a $200,000 plant, with twenty miles transmission, in the Northern part of the State.

THE COMMERCIAL CABLE CO.

The Commercial Cable and Telegraph Company has been incorporated at Albany with a capital of $100,000. The general route of the company is from New York City to Mojave, Cal., touching all important cities on the route and having branches from the main line throughout all States traversed: also through the New England and Southern States and from New York to England and France. The directors include John W. Mackay, Albert B. Chandler, Dumont Clark, William C. Baker, Clarence H. Mackay, G. G. Ward, William C. Van Horn and Charles R. Hosmer.

PERSONAL

A ROYAL ELECTRICIAN.

The Prince of Naples is perhaps the only real electrician among all the present Princes of Europe. He is very learned in all that concerns the application of electricity to light, motive power, sound and photography. He was one of the first and most successful experimenters with the X-rays after their discovery, and in Rome his residence in the Quirinal had the aspect, during His Royal Highness' bachelor days, of a scientific laboratory. It is said that the Emperor William of Germany and his staff took recently an electrical course in up-to-date subjects.

MR. E. T. BIRDSALL, M. E., has sailed on La Touraine for Paris, whence he goes to London on tramway business. He will then sail direct for the Argentine Republic, where he is to instal about 150 miles of electric street railway. At Cordoba he is also to instal a 15-mile 3-phase transmission of 6,000 h. p.

MR. ARNOLD SPILLER, electrical engineer of the Edison and Swan United Co., of England, made a flying trip to this country last week on important business, arriving last Saturday, and sailing next Saturday.

PROF. JOHN S. McKAY, PH. D., is delivering a course of lectures for the Brooklyn Institute on "Chemical and Thermal Relations of the Current."

MR. TOM L. JOHNSON is leaving Cleveland to take up his permanent residence in New York City, where he has large interests and many friends.

PRESIDENT McKINLEY has had the plans of the Niagara Pan-American Exposition submitted to him, and is said to have expressed himself in warm approval of the project, which is now beginning to assume good shape and large proportions.

N. S. JOHNSON, manager of the Central Union Telephone Company, at Massillon, Ohio, shot himself last month, and left a letter saying he was threatened with blindness and had nothing to live for.

THE STOCK MARKET

EVERYTHING SAFE BUT CONGRESS.

THIS week Congress meets and upon that event hinges a good deal, but it is hoped and believed that little will be done to disturb the better conditions which now prevail generally through the country. At the same time, the new tariff is not yet producing all the revenue needed, and there is necessity for putting the currency on a more stable basis. If there is to be Congressional activity between now and next May, there are legitimate opportunities for its wise use.

The general trade outlook is good. In spite of well nigh unprecedented exports of grain, the price stays around $1 per bushel, and the stock in sight on December 1 was the smallest for ten years. Cotton is low in price, but the size of the crop appears to explain that. Merchandise exports are excellent; while many of our imports, such as tea and coffee, are cheaper than for many years. Bank clearings in 78 cities for eleven months are 10 per cent. ahead of last year. Chicago reports enormous gains lately. Business failures for the week were 250, against 359 last year. Railway earnings net and gross are uniformly good, and refunding plans like the Rock Island are making a most favorable impression. Retail merchants report the Christmas trade as remarkably brisk.

The stock market last week showed more general confidence and resumed the summer activity. The demand for good bonds has cleaned up the available supply, and any that Europe will part with are greedily absorbed. Some of the highest figures on record are being made. Of stocks, nearly two million shares exchanged hands. General Electric went from 32 to 33½ on sales of 3,830 shares. Western Union reached 89 on 13,793 shares. American Bell Telephone went up to 263½ on sales of 500 shares. New York Edison is firm at 125.

The Boston Advertiser financial says: The latest gossip on General Electric affairs is to the effect that a proposition may be soon made to the preferred stockholders to retire that stock at anywhere from 90 to par. It is further said that the company is supposed to have been earning a surplus beyond the

7 per cent. which the preferred stock is entitled to, but it seems to be the policy of the management to let it accumulate and compromise by purchasing the stock.

Copper is quoted 10¾ New York; steel rail, $19 to $22.50, according to section, etc.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOVEMBER 23, 1897.

Alarms and Signals:—

AUTOMATIC ELECTRIC BURGLAR ALARM. J. W. Baughman, Dalton, Ohio, 594,192. Filed March 25, 1897. Details of construction.

ELECTRIC RAILWAY SIGNAL AND SAFETY DEVICE. K. Kohn, Seward, Neb., 594,256. Filed March 8, 1895. Means whereby an audible signal is operated on each locomotive and simultaneously therewith the air brakes are applied and the throttle valves are closed.

AUTOMATIC SIGNALING SYSTEM. C. W. Price, Newark, N. J., 593,281. Filed Jan. 11, 1897. Similar to 594,034.

RAILWAY SIGNAL. J. D. Taylor, Chillicothe, Ohio, 594,300. Filed April 2, 1897. An electric bell is placed near the crossing and is automatically thrown into circuit by a train approaching and cut out of circuit by the train when it passes.

MEANS FOR INDICATING MOVEMENT OR CESSATION OF MOVEMENT OF FLUIDS. O. Carpenter, Pawtucket, R. I., 594,323. Filed Dec. 5, 1896. Consists of an indicator having a magnetic body adapted to be moved by the fluid, and a magnetic alarm actuated by the magnetic body.

Batteries, Secondary:—

ELECTRIC BATTERY. D. S. Williams, Philadelphia, Pa., 594,051. Filed Aug. 23, 1895. Embodies a conductor and support for the active material formed of a single sheet of metal cut out and then bent transversely upon itself to form a series of superposed channeled plates united by integral yielding conducting strips.

STORAGE OR SECONDARY BATTERY. R. Ashley, Port Republic, N. J., 594,313. Filed April 25, 1896. Embodies superimposed trays each consisting of a rectangular base, outwardly-flaring upwardly extending sides and supporting lugs on the inner sides at the corners.

Conductors, Conduits and Insulators:—

APPARATUS FOR FEEDING CABLES INTO UNDERGROUND CONDUITS. W. H. Johnston, St. Louis, Mo., 594,020. Filed July 28, 1897. Comprises a tubular guide, that can be bent only into curves of comparatively large radius, and means for attaching it at one end to the duct of the conduit.

SECTION INSULATOR. J. Hoffman, Schenectady, N. Y., 594,155. Filed Aug. 7, 1897. Comprises a body of insulating material having metallic end pieces secured to it and having a transverse flange engaging the body.

ELECTRIC CABLE. J. D. Gould, Brooklyn, N. Y., 594,247. Filed Jan. 11, 1897. Comprises a fusible core covered by insulating material, a series of conductors wound spirally around the insulating material, and an insulating cord wound between adjacent spirally wound conductors.

Dynamos and Motors:—

INDUCTOR DYNAMO. C. P. Steinmetz, Schenectady, N. Y., 594,-145. Filed Aug. 12, 1897. Comprises a revolving inductor and a stationary armature, the latter having portions of laminated iron and a solid yoke, with an auxiliary air-gap in the armature iron. See page 560

STARTING DEVICE FOR ALTERNATING CURRENT MOTORS. W. J. Foster, Schenectady, N. Y., 594,150. Filed Jan. 4, 1896. Embodies a bridge of magnetic material adjacent to the polar faces of the induced member.

Electro-Metallurgy:—

APPARATUS FOR ELECTRICALLY HEATING METALS AND ORES. G. D. Burton, Boston, Mass. 593,981. Filed Feb. 20, 1897. An apparatus for heating metals to a fusing point and for smelting ores by means of an electric arc formed between the ores and metal and an electrolytic bath.

Measurements:—

SEPARABLE RECORDING METER. J. R. Cravath, Chicago, Ill., 593,986. Filed Aug. 12, 1897. The recording part is readily removable from the operating part for convenience in reading.

Miscellaneous:—

HEAT REGULATING APPARATUS. C. L. Fontier, Milwaukee, Wis., 594,346. Filed Sept. 12, 1896. Employs direct current. Details of construction.

Railways and Appliances:—

TROLLEY. R. W. Clarke, Victoria, Canada, 593,984. Filed Feb. 17, 1897. Permits the passage of two cars running in opposite directions whose trolleys are traveling upon the same feed wire.

INDICATOR FOR UNDERGROUND ELECTRIC RAILWAYS. H. C. Reagan, Jr., Philadelphia, Pa., 594,122. Filed June 4, 1896. An indicator to show when the contacts are out of order in a sectional underground conduit railway.

Regulation:—

REGULATION OF ALTERNATING CURRENT SYSTEMS. C. P. Steinmetz, Lynn, Mass., 594,144. Filed Dec. 22, 1893. Combines in an alternating current system, a source of out-of-phase waves of current or electromotive force between the feeding mains and a branch of the system, and a phase modifier in the branch subcircuit.

Roentgen Rays:—

ROENTGEN-RAY TUBE. H. L. Sayen, Philadelphia, Pa., 594,036. Filed April 29, 1897. Comprises a high vacuum tube, a shunt circuit arranged in proximity thereto, and means connected with the above and set into operation by the current in the shunt circuit to cause gas to enter the tube.

REGULATING ROENTGEN RAY TUBES. M. P. Rice, Schenectady, N. Y., 594,143. Filed July 17, 1897. Consists of a shunt circuit including in the path of its current a volatile salt, and a resistance consisting of a tube filled with water or other liquid.

ROENTGEN RAY TUBE. I. W. Howell, Newark, N. J., 594,156. Filed August 26, 1897. Consists in passing a current proportioned to the resistance of the tube through a suitable salt in the vacuous inclosure.

Switches, Cut-Outs, Rheostats, Etc.:—

RESISTANCE DEVICE. G. K. Cummings, Chicago, Ill., 593,988. Filed Dec. 23, 1895. May be employed for regulating an electric current or used as an electric heating device.

AUTOMATIC CIRCUIT CONTROLLER. C. W. Price, Newark, N. J., 594,034. Filed March 23, 1897. An electro mechanical controller for an electric signal circuit.

ELECTRIC SWITCH. A. C. Brockles, London, Eng., 594,227. Filed June 7, 1897. Of the "tumbler" type.

ELECTRIC TIME SWITCH. A. B. Williams, Waco, Tex., 594,306. Filed July 7, 1897. Designed to switch the lights on or off shop-windows. Details of construction.

Telephones:—

TELEPHONE. T. Berdell, New York, 594,060. Filed Dec. 27, 1895. Consists of two flexible diaphragms rigidly held at their peripheries and free and unencumbered at their centers and having granular material held there between and around the central unoccupied space.

BELL EXTENSION FOR TELEPHONES. E. S. Dickerson, Philadelphia, Pa., 594,131. Filed Aug. 11, 1897. Means whereby the call of the instrument may be transmitted to an auxiliary call remote thereto.

TELEPHONE SYSTEM. A. F. Swan, Bayonne, N. J., 594,363. Filed Dec. 10, 1896. Party line system adapted to work on open circuits.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED NOVEMBER 30, 1897.

Alarms and Signals:—

SIGNALLING SYSTEM. H. A. Chase, Boston, Mass., 594,382. Filed Jan. 23, 1893. Adapted for police and fire signal work.

OVERFLOW ALARM. C. Johnson, Chicago, Ill., 594,403. Filed Sept. 18, 1897. Designed for refrigerator pans.

ELECTRICALLY CONTROLLED BLOCK SIGNAL FOR RAILWAYS. R. J. Hewett, St. Louis, Mo., 594,471. Filed Aug. 20, 1896. Employs two sets of signals—one set for each direction.

TEMPERATURE INDICATING STIRRING APPARATUS. M. Henius, Chicago, Ill., 594,533. Filed March 29, 1897. An indicating apparatus is located in a circuit closed by a thermostat on the stirrer.

AUTOMATIC HIGH PRESSURE ALARM. C. W. Bemish, Tacoma, Wash., 594,514. Filed Jan. 9, 1897. Designed for use on steam boilers. Details of construction.

MECHANISM FOR MAKING, BREAKING AND SWITCHING ELECTRIC CIRCUITS FOR RAILWAY SIGNALS. P. H. Forbes, C. C. French and A. Lee, Topeka, Kansas, 594,614. Filed March 26, 1897. Details of construction.

ELECTRIC BURGLAR ALARM. T. A. Clarke, Bootle, Eng., 594,-678. Filed Jan. 12, 1897. Comprises a hinged wedge adapted to be placed with the thin end under a door and to close an alarm circuit on the opening of the door.

BURGLAR AND FIRE ALARM. J. H. Ellis, Prescott, Ark., 000,-000. Filed March 16, 1897. Comprises a bar provided with two studs in combination with pivoted levers formed with hammer heads, clamps provided with thumbscrews, a spring centrally secured in the clamps, detachable props and jingle bells located in the path of the free ends of the levers.

Distribution:—

LAMINATED CONVERTER CORE. F. Schwedtmann, St. Louis, Mo., 594,657. Filed April 5, 1897. An element consisting of a T-shaped plate having two short arms and a long arm, and two similar U-shaped plates each having a long arm and a short arm, the ends of the arms of plates abutting.

Dynamos and Motors:—

POLYCIRCUIT DYNAMO. I. R. Prentiss, Cleveland, O., 594,488. Filed Nov. 9, 1896. Embodies separate independent circuits, each connected with part of the poles and their corresponding brushes and disconnected from the other poles and brushes.

POLYCIRCUIT DYNAMO. I. R. Prentiss, Cleveland, O., 594,489. Filed March 31, 1897. Embodies a closed coil armature having the brushes under each pair of field magnets of opposite polarity connected in series with an external circuit.

COMMUTATOR. C. J. Greiner, St. Louis, Mo., 594,687. Filed Aug. 31, 1897. Designed to interrupt or alternate a direct current as the current is passed through the device.

POLE CHANGING MECHANISM FOR ELECTRIC GENERATORS. P. Kennedy, Brooklyn, N. Y., 594,745. Filed April 26, 1897. Adapted for use in electric lighting systems for cars, in which the generator is driven from an axle of the car.

Electro-Metallurgy:

METHOD OF AND APPARATUS FOR REMOVING ZINC FROM ZINCIFEROUS ORES. S. H. Emmens, New York, 594,611. Filed March 6, 1896. Consists in pulverizing and roasting the ore, leaching it in a series of vessels through which a solution flows continuously, and subjecting the contents of each vessel intermittently to electrolytic action.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. H. R. Quinby, Rochester, N. Y., 594,426. Filed Feb. 18, 1897. Comprises tubular armatures having a removable lower end provided with a tapering recess, a collar operating in the recess, having apertures, and balls in the apertures co-operating with the walls of the recess to clamp the carbon passing through the armature.

ELECTRIC ARC LAMP. T. E. Adams, Cleveland, O., 594,585. Filed Jan. 21, 1897. Electrode guide for focussing arc lamps.

ELECTRIC ARC LAMP. T. E. Drohan, Chicago, Ill., 594,682. Filed July 9, 1897. Feed mechanism for arc lamps.

Miscellaneous:—

AUTOMATIC LIGHTING DEVICE FOR GAS BURNERS. H. Borchardt, Berlin, Germany, 594,376. Filed Feb. 12, 1897. Details of construction.

COMBINED GAS AND ELECTRIC GENERATOR PLANT. S. H. Short, Cleveland, O., 594,435. Filed May 4, 1896. For description See page 558.

PROCESS OF AND APPARATUS FOR CARBURETING CALCIUM. H. L. Hartenstein, Bellaire, O., 594,740. Filed Jan. 7, 1896. Consists in calcining limestone and then forcing into the calcined mass while in a heated condition a carbonaceous material by the aid of a combustible gas under pressure and simultaneously subjecting the mass to the action of an electrical current.

MARINER'S COMPASS. O. Kustel, San Francisco, Cal., 594,803. Filed Feb. 17, 1897. Details of construction.

Railways and Appliances:—

ELECTRIC SYSTEM OF PROPULSION. W. M. Brown, Johnstown, Pa., 594,379. Filed May 11, 1897. Comprises a magnet carried by a car having energizing coils comprising two distinct sets of windings, one being in shunt with the motors and the other being in series with the motors.

ELECTRIC CONTACT DEVICE AND CONDUCTOR CONSTRUCTION THEREFOR. J. McK. Dortch, Johnstown, Pa., 594,386. Filed Jan. 19, 1897. Comprises a contact device, carried by the conductor having a plurality of supporting portions, and camfaces in alinement with the conductor hangers.

TRAVELING CONTACT DEVICE FOR ELECTRIC RAILWAYS. M. D. Law, New York, 594,406. Filed July 8, 1896. Embodies a block of carbon in immediate contact with the conductor, and a spring actuated support for the carbon block.

ELECTRIC BRAKE. S. H. Short, Cleveland, O., 594,493. Filed May 10, 1897. Comprises circuits closed upon themselves in a closed magnetic field, and means for inducing heavy currents in the closed circuits.

ELECTRICALLY OPERATED SWITCH. W. D. Stanton, Springfield, Mass., 594.575. Filed Jan. 14, 1897. Electro magnets are employed to shift the switch rail.

ELECTRIC BRAKE. W. Weihl, New York, 594,665. Filed Oct. 22, 1896. Electro-mechanical brake.

ELECTRIC PLEASURE RAILWAY. L. Lilley, Cincinnati, Ohio, 594,700. Filed Feb. 4, 1896. Consists of inclined railway tracks leading to the base of a dark tower and thence spirally around the inside of the outer wall of the tower to the top, the track leading to the base of an observation tower, with a spiral railway arranged around the outside.

ELECTRIC RAILWAY. R. Lundell, Brooklyn, N. Y., 594,702. Filed Aug. 24, 1896. Surface contact system. Details of construction.

ELECTRIC RAIL BOND. S. W. Huff, Baltimore, Md., 594,800. Filed Aug. 29, 1896. Comprises a flat metal body portion composed of a number of parts which render it flexible edgewise, and attaching-lugs integral with the ends of the body portion and formed of the same original body of metal.

TROLLEY GUARD. L. H. McNett, Eldora, Iowa, 594,807. Filed July 25, 1896. Details of construction.

LOCOMOTIVE FOR TOWING CANAL BOATS. E. A. Leland, Great Barrington, Mass., 594,832. Filed Feb. 20, 1897. Employs an electric locomotive moving along a railway on the towpath of a canal.

Regulation:—

MEANS FOR CONTROLLING ELECTRIC CURRENTS. P. Kennedy, Brooklyn, N. Y., 594,744. Filed April 26, 1897. Means for regulating current on a circuit in which are lamps and an accumulator, as in a car lighting system.

REGULATING ELECTRIC MOTORS. A. G. Davis, Washington, D. C., 594,779. Filed Nov. 17, 1896. Comprises a plurality of motors coupled in tandem, and phase advancing devices adapted to neutralize, in whole or in part, the self induction of the intermedite circuits.

Switches, Cut-Outs, Etc:—

ELECTRIC SWITCH. G. W. Hart, Hartford, Conn., 594,470. Filed April 20, 1896. Consists of an index for snap switches.

ELECTRIC SWITCH. M. Guett, Hartford, Conn., 594,618. Filed May 29, 1897. Push button flush switch. Details of construction.

ELECTRIC SWITCH. F. Schwedtmann, St. Louis, Mo., 594,656. Filed Dec. 14, 1896. Comprises a switch blade carried by a pivot post, a contact post, a plurality of contact springs at each side of the contact post and carried by it, the springs of each set being divided into a number of parts and the division arranged out of register.

Telephones:—

TELEPHONE LINE SWITCH. G. Lay, Licking, Mo., 594,407. Filed Oct. 10, 1896. Comprises a movable pair of connected metallic arms, a second pair of such arms, insulated bridging-strips on one arm of each pair, and stationary contact-points connected to the line-wires, and an intermediate connecting plate spanned by the bridging strips.

MARRIED

McCONNELL—O'CONNOR.

The large circle of friends and acquaintances in the electrical field, of Mr. Walton Jerome McConnell, now the Western representative of The Electrical Engineer, will be delighted to learn of his marriage to Miss Hortense O'Connor, daughter of Mr. and Mrs. John F. O'Connor, of Galveston, Tex. The wedding took place on Thanksgiving Day. The happy pair will be at home after December 8, at the Normandie, Chicago. Mr. O'Connor is a well known engineering contractor and is at present government contractor on the $6,000,000 U. S. jetty at Galveston.

TRADE NOTES & NOVELTIES

NEW G. E. STREET CAR LAMPS.

THE important feature in lamps intended for use on railway circuits is long life without decrease in brilliancy. To secure this both mechanical strength and uniformity of product are essential. Railway lamps should be uniform not only in size, shape and appearance, but absolutely so in current consumption. Both length of life and sustained candlepower depend upon such uniformity, and while the former is the most desirable characteristic, it should not be forgotten that lamps are primarily made to give light. Practically any length of life can be secured in lamps of low efficiency—lamps consuming a large amount of power; but power is not had for nothing, and while one lamp may last longer than another, it may consume so much current, as to make it cost more than a lamp of shorter life consuming less current.

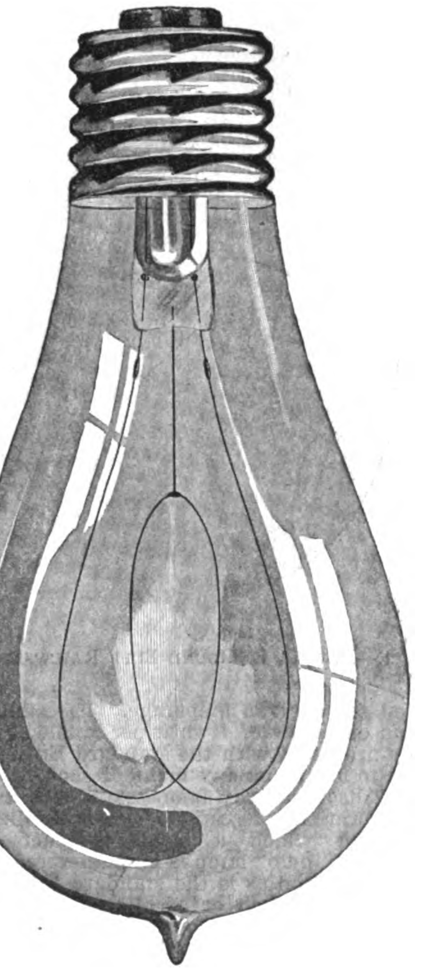


FIG. 1.—NEW G. E. RAILWAY LAMP.

Furthermore, a lamp may have a very long life, and yet be so dim as to make it worthless, consuming current without giving a proper return in life. The ideal lamp, therefore, is that in which the average life is combined with average candlepower and energy consumed to give the best lighting service for the least cost, including lamp renewals and power consumed.

In the Edison railway incandescent lamp, the results above are obtained, first, by its mechanical strength, the filament, of cellulose with a hard graphitic carbon coating, being so shaped and anchored as to protect it, as well as the bulb, from injuries likely to occur from the vibration and shock inseparable from street car service. The anchoring of the filament is essential. An unanchored filament must necessarily be so stiff and short as to limit the light to a small area. This reduces both the efficiency and sustained brilliancy of the lamp. The position

of the anchor is also of importance. To anchor the lower end of the filament to the inside of the bulb is considered objectionable. The filament is held too rigidly, exposing both it and the anchor to rupture in case of jar or shock. Rigidity can be eliminated by loosely resting the filament in the loop of the anchor, but the friction of the filament in the loop quickly wears it away. In the Edison lamp the anchor is set in the stem and the vibration of the filament is rather checked than entirely prevented. It is thus not strained nor weakened, as both filament and anchor vibrate together, and no chance exists of the branches interlocking and short circuiting, as would probably be the case if one loop of the filament were anchored to the side of the bulb and the other left free to vibrate and strike against it.

As railway lamps are operated in series, the current capacity should be uniform. Edison railway lamps are, therefore, made in three different classes—for 500 volt circuits, for 550 volt circuits, and for 600 volt circuits—in each class the lamp

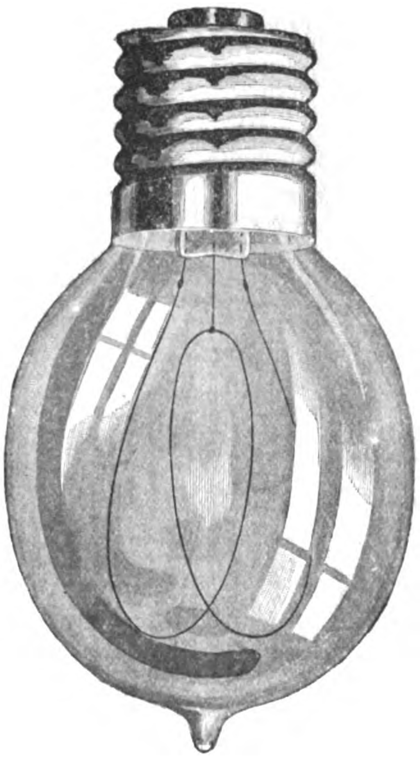


FIG. 2.—NEW G. E. ROUND BULB RAILWAY LAMP.

being selected for a given amperage. The standard railway lamps have an efficiency of 4 watts per candle at full 16 candle-power. They are fitted with the standard Edison screw base, or with bases to fit almost any make of socket. Fig. 1 shows the standard Edison railway lamp—exact size and shape.

For the decoration of cars or for headlights, or special locations in which a small compact bulb is required, the "round bulb" lamp is manufactured. Its filament is shaped and anchored as is the standard railway lamp, and both are furnished frosted or of almost any desired color—either artificially dipped or in natural glass. Fig. 2 shows the "round bulb" lamp—exact size and shape.

The best lamp can be so misused as to render it worthless, while by proper use the maximum of life and light is obtained. Such use demands that the same amperage and make in lamps be used on the same car or series; that they be ordered to suit the total voltage of the circuit, and that the lamps which have become dim from age be at once replaced by new ones. And this last requirement is necessary if light is to be economically produced.

P. & B. SPECIALTIES.

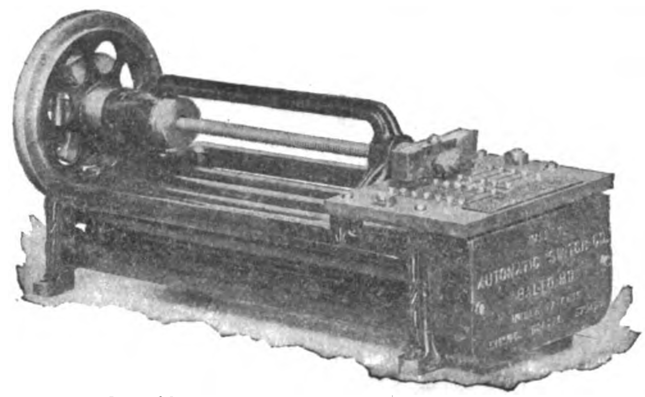
It is just about this season of the year that most street railway and electric light companies are making their repairs and are in need of a good insulating tape and motor cloth for street car purposes. These necessities the Standard Paint Company are ready to supply of the best quality in the largest quantities. Their Ruberoid motor cloth is extremely elastic, and very durable, and is meeting with a large sale. Good big samples will be sent to anyone desiring to test the material. The Standard Paint Company are also making a specialty of a cheap, reliable paint for iron work, conduits, etc. Notwithstanding its price, it is said to be much more durable than many of the so-called insulating paints that are offered from time to time.

The company's P. & B. compound is increasing its sale everywhere, and is to-day in larger use throughout the country than at any previous period in its history.

NON-MAGNETIC AUTOMATIC MOTOR STARTER.

THE accompanying engraving illustrates the latest development in the line of motor-driven starters made by the Automatic Switch Company, of 703 Equitable Building, Baltimore. It is claimed to be the acme of simplicity and durability.

While its action is rendered automatic by the use of centrifugal force, the powerful movement of the contact rod is the result of a positive thrust taken directly from the pulley and is



NON-MAGNETIC AUTOMATIC MOTOR STARTER.

not affected by variations of speed when starting, neither will a subsequent overload of the motor have any tendency to replace the starting resistance in circuit.

The absence of dash-pots, solenoids, magnets and latches of any kind make this apparatus particularly reliable and satisfactory. It will be found useful on any class of work where it is not necessary to re-start a motor before it has come to a standstill.

NIAGARA POWER LINE.

J. G. White & Co. have finished recently their increase of the Niagara power transmission line, and have put up the duplication of the first three-phase circuits already in use. They have strung all this large amount of bare copper line along the pole line without shutting off the power; and if it had not been necessary to change some of the poles along the canal bank, and some of the underground subway, it would not have been necessary at all to shut down the line on account of the new construction. But in deepening and widening the Erie Canal, practically all the underground work done last year along the towpath had to be destroyed, and this also made it incumbent on the engineers to move some of the poles. The bare cable of the American Electrical Works was used again for the overhead work. The underground conductor is a single cable, with triple 0000 strands in it. It is rubber, lead encased, 2⅝ inches in diameter, made by the General Electric Company.

NEW B. & O. ELECTRIC LIGHT PLANT AT PHILADELPHIA.

In accordance with the policy of economy adopted by the receivers of the Baltimore & Ohio Railroad, an electric lighting plant has been installed at Philadelphia for the purpose of lighting the passenger station, yards, freight stations, freight yards, docks, roundhouses, machine shops, etc. Twice as many lights are in service now as when the company purchased the current from local lighting companies, yet the expenses have been reduced one-half.

The Philadelphia plant consists of one 150 h. p. boiler, and two 50 General Electric arc light generators, which are belted to a 125 h. p. standard Westinghouse engine. It took 20 miles of wire for the overhead construction and a sub-marine cable is used in crossing the Schuylkill River.

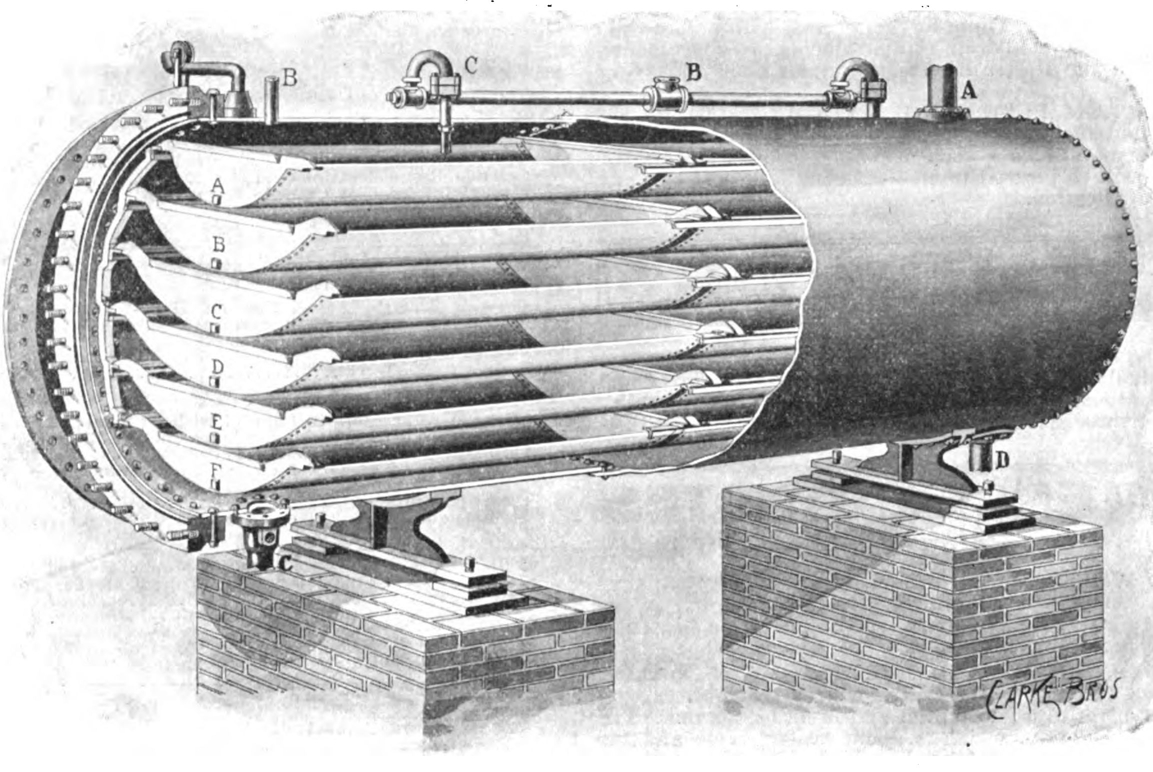
BALTIMORE, MD.—The Central Railway Company has equipped its trolley power plant with a storage battery of 265 cells from the Electric Storage Battery Company of Philadelphia.

THE HOPPES FEED WATER HEATER.

IN the remarkable compact electric plant of the Flushing, L. I., Electric Light Co.'s plant described in our last issue, mention was made of the use of the Hoppes feed water heater and purifier.

The water available for use in the boilers is highly charged with carbonates and sulphates of lime and magnesia. To prevent the formation of scale in the oilers the water is passed first through a 400 h. p. Hoppes exhaust steam feed water heater where it is heated by the exhaust steam from the boiler feed and condenser pumps.

From the heater it is pumped to a 400 h. p. live steam feed water purifier, illustrated in the accompanying engraving, where it is heated to boiler temperature and all the solid matter contained in the water, whether in solution or suspension, is deposited on the trough-shaped pans inside the purifier. This water is so heavily charged with solids in solution that it was deemed unfit for boiler purposes, but with the use of the Hoppes purifier they keep their boilers free from scale.



THE HOPPES FEED WATER HEATER.

SPRAGUE AND INTERIOR CONDUIT REMOVAL NOTICE.

THE following important notice appears in our columns with reference to the Sprague and Interior Conduit interests now comfortably settled down in the Commercial Cable building, on Broad street, in which they occupy the whole fifteenth floor clear through, giving them the whole hallway and sixteen large rooms. The company celebrated opening its new offices on Monday by securing on the same afternoon a contract for no fewer than 19 Sprague electric elevators for the new Union Terminal Depot, in Boston, where four more will also be required as soon as their location can be determined. The removal notice is as follows:

The lately organized Sprague Electric Company has taken up its permanent abode in the Commercial Cable building, 20 and 22 Broad street, from whence will shortly issue catalogues, circulars, pictorial, diagrammatic and other announcements concerning the wares of the Sprague Electric Elevator Company and the Interior Conduit and Insulation Company, as well as of certain lines of new electric work which the company has secured the control of and which it is preparing to put upon the market with all possible dispatch.

Inquiries as to interior conduits and Lundell motors should be addressed to the Interior Conduit and Insulation Company, 20 and 22 Broad street, New York, and inquiries as to Sprague electric elevators, the new Lundell dynamos, or in respect to Sprague's new system of multiple unit railway control should be addressed to Sprague Electric Company, 20 and 22 Broad street, New York.

POPULARITY OF THE COMING ELECTRICAL EXHIBITION.

Interest in the next electrical exhibition is taking a very substantial shape. The demand for space is even larger than was looked for, and it comes from the leading representative firms in the electrical, steam and kindred trades. They are planning to spend money liberally in making their exhibits attractive.

Madison Square Garden will afford plenty of scope for this sort of work, and present indications point to a remarkably brilliant display.

MATHIESON ALKALI AT NIAGARA.

The Mathieson Alkali Company, of Niagara Falls have started one unit of cells in their new works, which are located on the property of the Niagara Falls Power Company, the electric power being supplied from the last mentioned company's central power station. That portion of the plant now in operation represents only about one-tenth of the total capacity of the works. The remaining cells will be started as soon as they are in readiness for operation. The product of the plant will be caustic soda and bleaching powder. The works are among the most extensive of the electro-chemical plants at Niagara Falls.

TERRE HAUTE, IND.—The Electric Railway Company has been authorized by the receiver to raise $23,000 for new boilers.

NEW YORK NOTES.

MR. J. C. MOULTON, formerly with the Sawyer-Man Electric Company, also the A. B. C. Company, has recently severed his connection with the Rochester Lamp Company, to re-enter the electrical field. He is now with the Columbia Electrical Supply Company, at 329 Fourth avenue, where he will be pleased to receive his friends.

MR. THOS. A. EDISON, JR., a worthy "chip of the old block," has opened an office at 96 Broadway, and is selling an "Edison Junior" incandescent lamp as a specialty.

MR. HUGO REISINGER, of 38 Beaver street, sole agent of the celebrated "Electra" highest grade Nuernberg carbons, informs us that the outlook for the present season is most promising. The large and numerous orders that have lately reached

him, prove not only an increase in business, but that station managers are fully aware of the advantages he offers them. The European factory Mr. Reisinger represents has been enlarged recently, thus enabling him to fill orders for the largest quantities of carbons on short notice.

THE FOSTER ENGINEERING CO., of Newark, N. J., state that their October and November business has broken all previous records. Among the large orders received they note 104 valves of sizes from ¾-inch to 8-inch for the new office building, Broadway and Rector street; seven 10-inch valves, for the Madison Avenue Electric Railway Line; other 18-inch, 10-inch and 8-inch orders, and a contract for 63 valves for three U. S. battleships under construction by the Newport News Shipbuilding and Dry Dock Company. In addition to these, their agent in Great Britain has ordered a full line of Foster regulators up to 12-inch, inclusive, and their agent on the Continent has orders from the Krupps of Germany and for the railroads of Russia, Germany, France, Austria, Holland, Belgium and Switzerland. These foreign orders, with others from our own railroads, industrial establishments, electric plants, etc., have kept the Foster Engineering Works busy in every department.

THE CHICAGO FUSE WIRE AND MFG. CO., of 853 Broadway, and factory at Chicago, report receiving large orders for fuse wire; also a good demand for their fuse repair kits. They will be pleased to mail circulars and prices to any address on application.

WESTERN NOTES

THE CENTRAL ELECTRIC CO. announce that they are carrying full lines of the Bryant, Perkins, Hart, Paiste and Anchor specialties, and are prepared to make shipments of any quantities of these well known goods from stock.

NEW ENGLAND NOTES

BIBBER, WHITE & CO., Boston, report a very satisfactory trade. Among the large orders received recently is one for the entire installation of dynamos and motors in the Tufts Building, Atlantic avenue, Boston.

FOXBORO FOUNDRY AND MACHINE CO., of Foxboro, Mass., whose building was recently destroyed by fire, are to rebuild their plant in a substantial and fireproof manner. The main foundry building, which is about 80 feet wide and 140 feet long, is being replaced by a steel frame structure. A traveling crane runway, for handling materials in the building, is being arranged for, and provisions are also being made for suitable jib cranes. The steel framework is being furnished and erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

ADVERTISERS' HINTS

CHARLES E. GREGORY CO., Chicago, Ill., present a long list of dynamos, motors and arc lamps which they have in stock and are ready for immediate delivery.

THE CENTRAL ELECTRIC CO., Chicago, suggest the use of Wagner transformers as one of the surest ways of reducing losses.

THE BERLIN IRON BRIDGE CO., East Berlin, Conn., offer an iron roof for sale. It was originally built for an iron foundry, but owing to the purchaser's failure it is offered at a bargain.

THE C. & C. ELECTRIC CO., 140 Liberty street, New York, advertise slow speed, closed ironclad motors, adapted to be bolted to floor, wall or ceiling.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, say that this is just the season of the year to make arrangements for supplies of lamps for the winter months and also to investigate the merits of transformers. They are ready to supply either lamps, information or transformers.

THE NEW YORK TELEPHONE CO. observe that a store without telephone service shuts its doors to business.

THE ANCHOR ELECTRIC CO., Boston, Mass., advise that "Anchor" switches be included when the list of supplies is made up.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXIV. DECEMBER 16, 1897. No. 502.

ELECTRIC LIGHTING

CONDENSING WATER COOLING TOWER AT HYDE PARK, CHICAGO.

IN view of the increasing interest that is being manifested by managers of electric light and power plants in cooling towers and other similar means for supplying water for condensing when the station is not located beside a river, lake or other natural water supply, many of our readers will no doubt be glad to know full particulars regarding the cooling tower and condensing arrangements recently put up by the Hyde Park Thomson-Houston Light Co., at Chicago.

The cooling tower idea is not new, but it is only recently that managers of plants have become awake to the fact that they can in this way make a saving of 20 per cent. or more in fuel with a small investment. From figures the writer has in his possession it appears that the cost of a cooling tower and condensing apparatus ought not to exceed $6 per horse power under ordinary conditions.

The credit for this move on the part of the Hyde Park Thomson-Houston Company is due to its manager, Mr. W. H. Schott. The station is located beside the Illinois Central Railroad tracks at Fifty-third street, Chicago, and is in the midst of a fine residence district with high-priced land on all sides of it, and while not far from Lake Michigan the expense of a water tunnel would have been out of the question under the circumstances.

The tower, as will be seen from the accompanying engravings, Figs. 1 and 2, which show it in two views, is built on the roof of the boiler room. To support the tower two plate girders 4 feet deep and 50 feet long were put on the roof with their ends resting on the boiler room walls. The tower is designed to cool condensing water for 1,000 horse power and has 20,000 square feet of cooling surface—somewhat more than the usual allowance in towers of this kind. It is 50 feet long and 25 feet high. The width at the bottom is 22 feet, at the top 12 feet.

The principle is shown in the diagram, in Fig. 1. The tower has 24 floors or pans. Each floor is level and is made of 1 by 6 inch fence lumber laid with ¼-inch cracks between boards for the water to trickle through. Each crack is over the middle of the board below; that is, the boards are staggered. On top of the plate girders 12 by 12 inch pine beams are laid crosswise at intervals of 8 feet. Then on top of these 12 by 12 inch timbers are laid lengthwise on which the floor system rests. The bottom floor is made as a sort of tank to provide, if necessary, for a depth of 10 inches of water over the entire bottom. Just under the tower are two shallow iron tanks with a capacity of 100 barrels each. The condensers are of the Baragwan..th siphon type and seem to be well adapted to this class of work as will be seen from the following description of the operation of the plant. The only function performed by the pumps is to elevate the water from the hot wells, into which the condensers discharge, to the top of the cooling tower. There the water is distributed through twenty-two openings and trickles down through the tower. It should be said here that to prevent wind from interfering with the water in the tower a screen of boards arranged shutter-like is put around it.

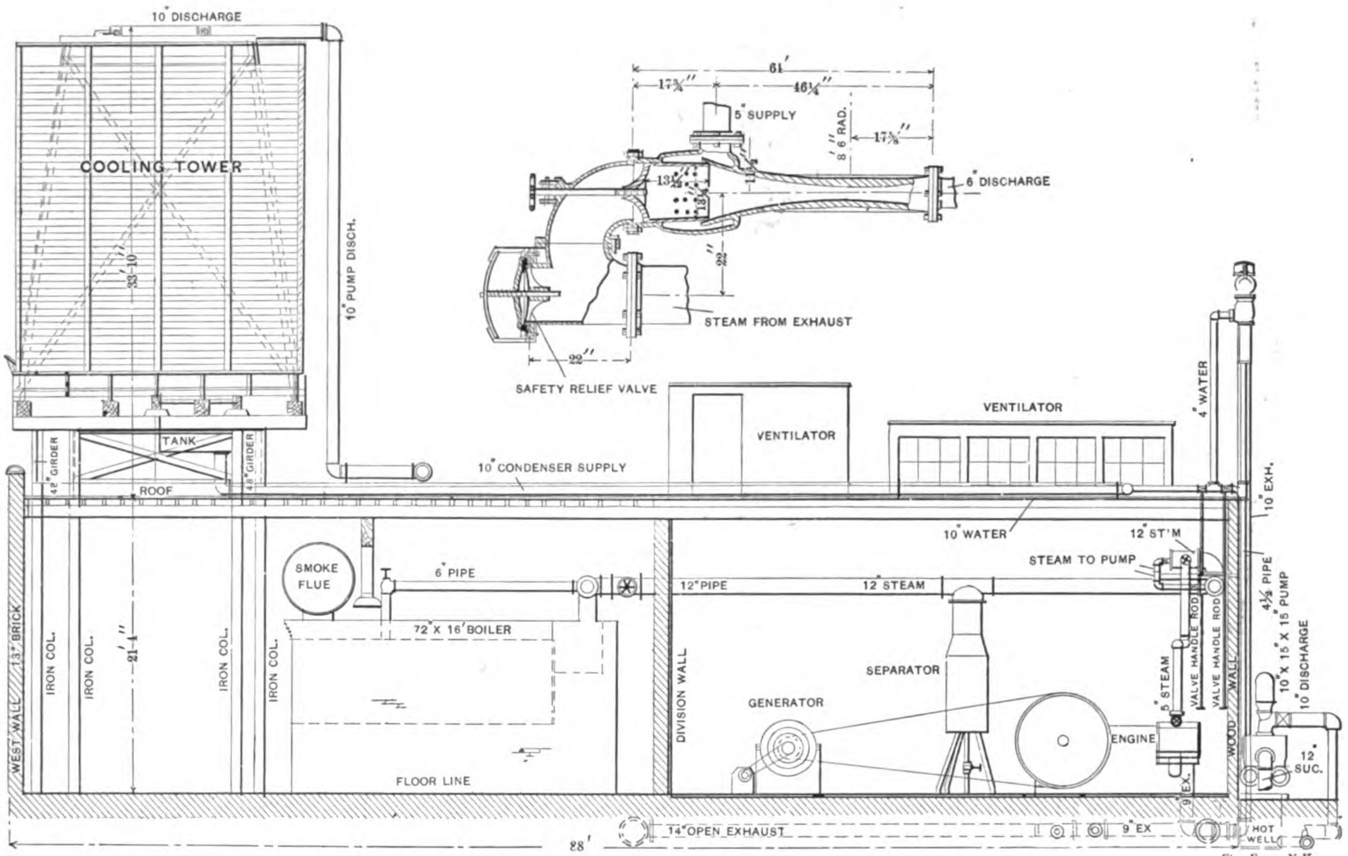


FIG. 1.—COOLING TOWER AND CONDENSING ARRANGEMENT, HYDE PARK, ILL., THOMSON-HOUSTON LIGHT CO.—SECTIONAL ELEVATION.

At the bottom of the tower the water runs into the iron tank. From there it runs across by gravity to the supply and suction pipe of the siphon condensers. These condensers are located above the roof about 34 feet above the level of the water in the hot wells below each. The steam from the engines rises through an exhaust until it reaches the condenser, the details of which are shown in Fig. 1.

In starting up an engine the pump is first started, which pumps water to the top of the tower and thereby puts a supply in the tanks under the tower which supplies the condensers as soon as the engine is started. About 10 per cent. more

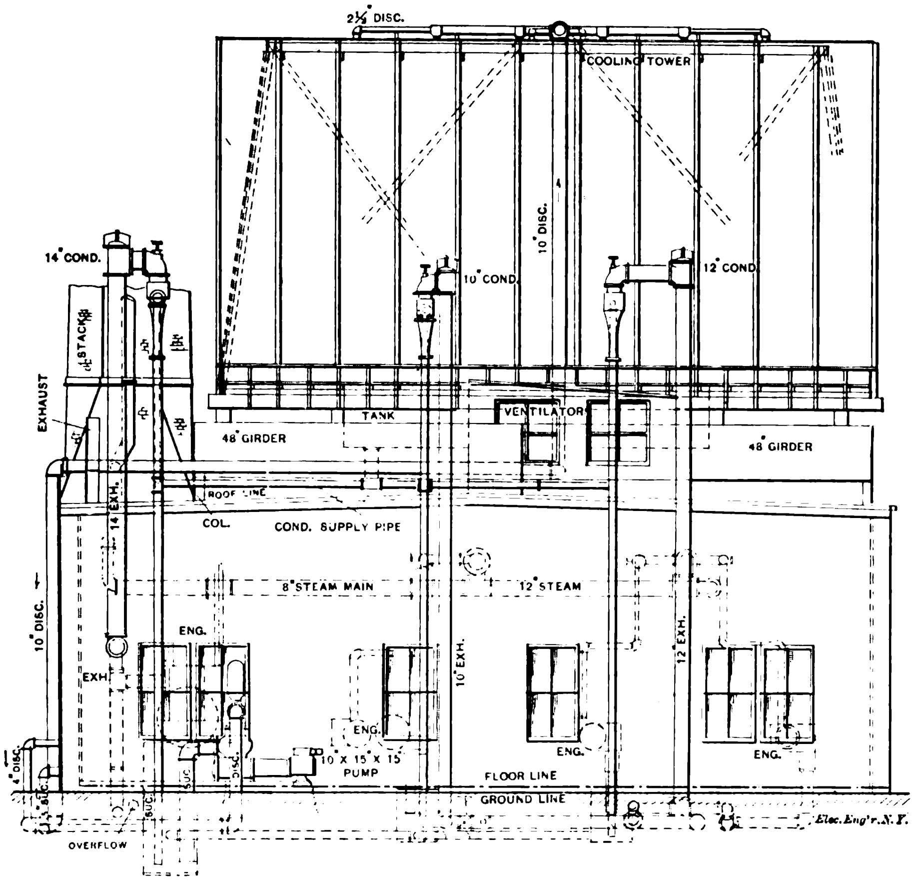


FIG. 2.—COOLING TOWER AND CONDENSING ARRANGEMENT, HYDE PARK, ILL., THOMSON-HOUSTON LIGHT CO.—SIDE ELEVATION.

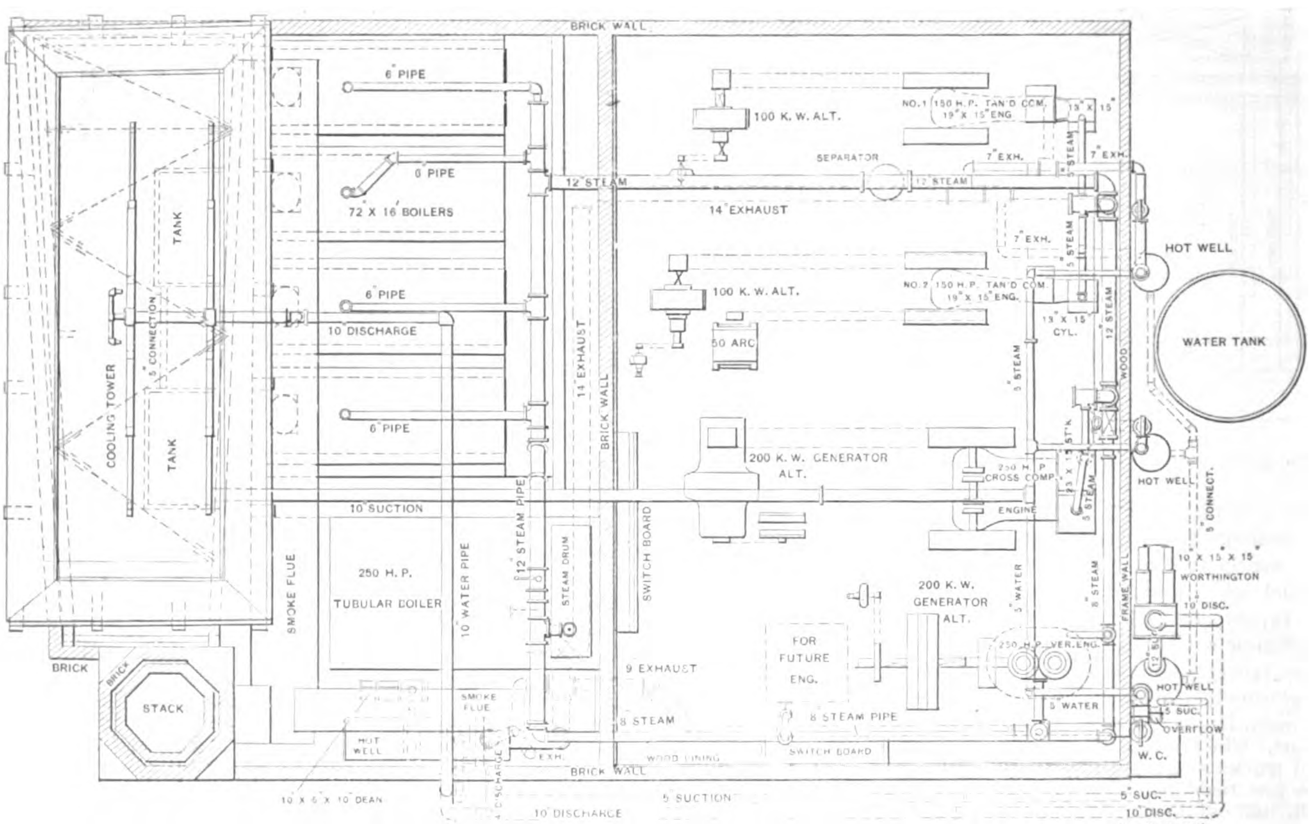


FIG. 3.—HYDE PARK, ILL., THOMSON-HOUSTON LIGHT CO.—PLAN OF ENGINES, BOILERS AND CONDENSING SYSTEM.

water is needed to supply the entire plant than would be necessary to supply the feed water to the boilers were the plant run non-condensing. This 10 per cent. is, of course, used up by evaporation while the water is running down the tower.

The hot wells are placed so that the water from all runs into one and the pump suction draws from the lowest well only.

The tower is now in continuous use for both night and day loads.

The plant is equipped with two McIntosh & Seymour tandem compound engines of 150 horse power; one cross compound Armington & Sims engine of 250 horse power and one 250-horse-power Willans engine. The introduction of condensing has increased the capacity of the station very materially. The dimensions of pipes is given in the accompanying engraving, Fig. 3, and Mr. Schott will be glad to furnish any further detailed information to those contemplating a similar move.

LIGHTING PLANT AT COLUMBUS, O., TO ENLARGE.

The Columbus, O., Electric Light and Power Co. has been sold to an Eastern syndicate in which Mr. Emerson McMillin is interested. The new company is to be capitalized at $700,000. Bonds in an amount equal to the capital stock are to be issued, though but $500,000 stock and the same amount of bonds are to be issued. The remaining $200,000 of each are to be deposited in the treasury of the new company as a reserve fund.

With the proceeds from the sale of the $500,000 bonds the new company intends to purchase the equipment for the plant and to make whatever alterations and improvements in the plant itself are found to be required, and in all probability they will be very extensive.

It is the purpose of this new company to make the plant thoroughly modern and up to date. The latest improved electrical machinery, etc., will be installed, with the view of reducing the cost of operation to the minimum. It is anticipated, for instance, to reduce the cost of fuel to nearly, if not quite, one-half that of the present system of operation.

NOTES ON RATING ELECTRIC POWER UPON THE HEAT UNIT STANDARD.[1]

BY W. S. ALDRICH.

IN the discussion which followed the presentation of the author's paper on this subject before the Hartford meeting, as well as in conference with members and other electrical and mechanical engineers since, it will appear that the following points have been brought out:

That the heat unit, as a basis for such ratings, is both rational and scientific. It is, however, not in consequence the most satisfactory standard for use by builders, contractors and practical engineers dealing with this class of motive power machinery, namely, steam engines and dynamos.

That great differences of opinion exist as to the proper definition of the heat unit required for such a standard. There are at least four different heat units commonly employed.

That the present extensive and satisfactory use of the heat unit for steam pumping installations is as it should be and is all right in that place; but this is no argument for its introduction and use in a similar manner in the rating of steam electric plants.

That the present way of stating the performance of electric power plants, however unsatisfactory, is easily understood by all parties interested. Chief of these, of course, is the capitalist; he can readily comprehend rating based on the coal bill.

That the load factor, after all, has not so much to do with the fuel economy of the plant, as such, however much the varying loads may individually affect any of the units of the installation, such as the steam engine. Therefore, in the large city and suburban steam power and electric plants now being installed, there is not the necessity for such strict adherence to economic load factors as in the case of plants with smaller units.

That the watt expresses the activity or rate of the electrical output, in joules per second. In this respect it is analogous to the horse-power rating of mechanical output. Hence, the standard rating should be in kilowatt hours per 1,000,000 B. T. U. supplied to the steam used in the whole plant.

That if the heat unit basis is considered as the proper standard for the steam electric plant, the whole heat supplied to the plant should be as carefully determined, and in the same manner, as now in vogue for similar ratings and contract trials for steam-pumping plants.

That the boiler should be in evidence in all cases in which plant performance is mentioned. In the electric plant it is economy of installation that is desired quite as much as in the case of pumping plants. Why should the boiler performance be urged into consideration in the former case and not in the latter? If it is a good thing to introduce it in either case it would seem proper to do so in both cases.

That the common rating of performance of pumping plants in foot-pounds per 1,000 pounds steam would be amply sufficient for all purposes of rating electric plants for which the heat unit basis is advocated. This seems particularly plausible on account of the small variation in the total heat of one pound of steam for quite a wide range of pressures now used in modern electric plants. Taking the standard temperature of feed water at 212 degs. F., exactly 1,000 B. T. U. are required to raise the temperature and evaporate one pound of feed water into steam at 77.3 pounds per gauge (92 pounds abs.). Taking this as suitable for a simple non-condensing engine, we may compare it with that of 150.3 pounds gauge (165 pounds abs.), in which 1,013.5 B. T. U. are required to raise the temperature from feed water (212 degs. F.) and evaporate it into steam at the given pressure. In this case, therefore, if we adopt 1,000 pounds steam instead of the 1,000,000 B. T. U., we make an error of only 1.3 per cent. It is claimed that this is within the usual allowable errors of observation and measurements in power plant tests, and that there is not enough difference to warrant the trouble required to obtain the performance reduced to a B. T. U. standard.

In this connection it is interesting to note the progress shown by the committee reports on data made to the National Electric Light Association. In eleven out of the fourteen cases noted in the report presented at the Buffalo meeting of that association, the water per kilowatt hour at best efficiency of the engine is noted. As the average temperature of the feed water in the best stations reported is from 208 to 212 degs. F., and the best results are shown by the compound condensing engines, we may conclude that the comparative water ratings are within about 1 per cent. of what such comparative ratings would be if based on the B. T. U. standard.

It is a question whether mechanical engineers will remain satisfied with results even within this close degree of approximation. The fact has been repeatedly pointed out by electrical engineers that their system of units is altogether unique, is thoroughly scientific (being based upon the C. G. S. system), and is the only system of engineering units universally adopted. Mistakes are said to be occasionally avoided in the sister profession of mechanical engineering by the insistence on the accurate use of terms and of units in electrical engineering. Dealers in electrical stocks and capitalists exploiting electrical enterprises generally have an appreciative insight into the meaning of volts, amperes and kilowatts. Why should the time-honored heat unit be so difficult of comprehension by the same class of interested citizens?

[1]Abstract of paper presented before Am. Soc. Mech. Engrs., December, 1897.

MISCELLANEOUS

SAFE CURRENT CAPACITY FOR ELECTRICAL CONDUCTORS.—II.

BY C. H. SEWALL.

(Concluded.)

TEMPERATURE limitations in an electrical current depend upon: 1. Electrical conductivity. 2. Extent of radiating surface. 3. Nature of radiating surface. 4. Nature and condition of surrounding medium. 5. Specific heat of metal.

Extent of radiating surface depends, first, upon form. A thin, flat strip having the greatest, a round solid wire the least. A stranded conductor has, for the same ohmic resistance a larger circumference than a solid one, and its surface is corrugated.

The accompanying diagram reduced in scale illustrates the effect of form on radiating surface. Fig. 1 represents the cross-section of a solid conductor 2.63" in diameter. Fig. 2 is the same circular millage made into a concentric strand of 37 wires. Fig. 3 is the same section in a cable containing seven strands, each strand of seven wires. Fig. 4, the same surface in a rectangular cross-section.

Approximately the distances around them, counting in all curves, in corrugations, are as follows:

Circle	8.27	linear inches
Strand	12.22	" "
Cable	14.14	" "
Bar	22.73	" "

and their radiating surfaces for equal lengths are in that proportion.

Roughened surfaces will give off heat faster than polished ones. If thoroughly blackened the coefficient of radiation is twice that of a polished surface. If covered with a black insulating covering radiation will be still further promoted. Prof. Forbes' calculations showed that the greater surface obtained by applying an insulating covering more than compensated, up to a certain thickness of coating, for the poor thermal conductivity of the insulator, and this was borne out by Kennelly's findings. Two of the latter's curves disclose the fact that a rubber-covered wire with an insulation 73 mils thick had a temperature elevation 30 per cent. lower than that attained by a wire of the same diameter, but only covered to a thickness of 11 mils. From the tests the evidence was distinct that the effect of an insulated covering was to cool the wires, i. e., if the covering was black; wire wound with white cotton was found to be higher in temperature, with the same current, than a bare one.

For a gutta-percha covering it is supposed that radiation will be better than rubber. Prof. Forbes makes the proportion of thermal conductivity as 48 to 41, in favor of gutta-percha as compared with rubber.

It is also highly probable that a conductor with an ordinary wall of insulating material encased in lead will bear more current than if protected by rubber or gutta-percha alone. Mr. Fisher, of the Standard Company, placed upon a wooden floor four cables running side by side in the form of an elliptical spiral. Unfortunately, full data are not given, but the calculated tables from the experiment show, for a rise in temperature of 25 degs. about the same figures as the National Code, and as the cables lying side by side must have heated one another, it is a fair inference that their radiating properties under even conditions are rather better than for unleaded wires Undoubtedly cables suspended in air will carry much more than the code allows. If underground much will depend upon conduit ventilation.

Fig. 1

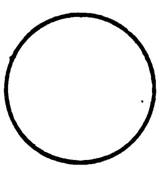


Fig. 2

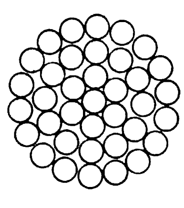


Fig. 3

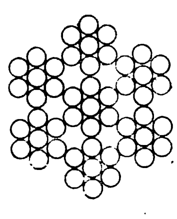
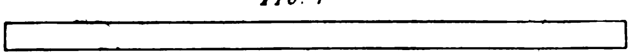


Fig. 4



FIGS. 1, 2, 3 AND 4.

After heat has been brought to the surface of a conductor and is radiating therefrom it causes the particles of air in its vicinity to move away and to be replaced by others which are again moved and replaced and so on. This process is called "convection." The experiments of 1889 showed that a No. 10 B. & S. bare copper wire in a room from which drafts of air have been carefully excluded, will be raised in temperature 18 degs. F., from 75 degs. F., by 26 amperes, and will require 42 amperes to bring it to the same temperature if the wire be suspended out of doors upon a calm, summer day. In a room guarded against outside drafts the agitation of a fan near a current-bearing wire sensibly decreased its temperature elevation.

The influence on radiation from convection and from color also may be seen by grouping figures from experiments for No. 0000 B. & S. gauge under four different conditions, viz.:

	Amperes.
Bright bare copper in a room with still air............	162
Blackened copper in a room with still air............	200
Bright bare copper, out of doors, calm weather......	322
Blackened copper, out of doors, calm weather........	340

starting with the same temperature elevation and attaining the same rise.

The influence of extent of radiating surface is shown by comparing code allowances for the same cross-section first in one conductor, No. 0000 gauge, 210 amperes; second, in two conductors of No. 0, 254 amperes, an increase of 21 per cent. The percentage increase from one 2,000,000 cm. conductor to two of 1,000,000 cm. each is from 1,050 to 1,300 amperes, or nearly 24 per cent. It may be convenient to remember that with large conductors there can be gained from 20 to 25 per cent. in cooling effect by making a lead of two conductors of one-half the cross-section required instead of using one conductor with the whole cross-section required.

While convection is not directly proportional to radiating surface, it seems to be to length, and Mr. Kennelly gives as an approximate rule that in still air the loss of energy due to convection has a mean value of 0.00175 watt per linear centimeter for each degree Centigrade of temperature elevation, or 1 kilowatt for every 114 meters at 50 degs. C. temperature rise.

Different quantities of heat are required to raise the temperature of a given weight of different substances a certain number of degrees. This is called specific heat. For the reason that the specific heat of iron is 25 per cent. greater than that of copper we may expect to find that iron wires safely carry more current than is indicated by their compared resistance with copper for the same cross-section.

For metals other than copper I have been able to find but little information. Mr. Preece in 1888 furnished very complete data on fusing effects, but as these involve the capacity of the metal to resist melting they are not reliable guides to effects of moderate heat. In a catalogue issued some years ago there are tables for carrying capacity of iron. These give for the equivalent in cross-section of No. 10 B. & S. in galvanized iron wire a maximum safe current of 12 amperes. The wires were placed in a wood frame, whatever that is, For tinned wires 12.3 amperes. These figures are about one-half the code allowance for same size rubber-covered copper wire. The resistance given in the same table (8½ times that of copper) indicates a low grade, electrically, of iron wire.

In the same book German silver, No. 10 B. & S., having a resistance 16⅔ times greater than copper, is allowed a safe carrying capacity of 8.5 amperes. The 18 per cent. German silver wire usually found in the market of to-day has a resistance 18 times that of copper. No further explanations as to conditions, etc., accompany the table just mentioned.

It is a law that the temperature of a conductor increases as the square of the current strength if the resistance is constant. As temperature rises, resistance increases; but it is also the fact that greater activity in radiation and convection tend to offset the effect of higher resistance and experiments have shown that in a wire which is given a fair chance to part with its heat the rule approximately holds good for an indefinite time. For the same reasons and under the same conditions with a given rise in temperature the square of the current varies as the cube of the diameter of a round wire.

The law governing safe temperature of a round wire is expressed by the formula, $C = ad^{\frac{3}{2}}$; where C is the proper current in amperes; d, the diameter; a, the constant, which is applied to suit conditions under which the wire is to be used. Kennelly's constant for insulated wire in moulding is 560, if d be in inches.

A solid No. 0000 B. & S. wire is .46 inch diameter. That figure raised to the $^3/_2$ power is, .312; $.312 \times 560 = 174.72$ amperes, which was for a long time the underwriter's rule for No. 0000.

As the limit has been raised to 212 for rubber-covered wires, it follows that the present constant is $212 \div .312$, or 680 (nearly) and for weather-proofed wires, $312 \div .312$, or 1,000.

For stranded conductors let us consider a familiar size, 500,000 cm., which, by the latest catalogue, Roebling's, is of a diameter, .819. For ease in computation call it .82 (for neither stranding, nor carrying capacity are as yet exact sciences); $(.82)^{\frac{3}{2}}$ is .742. Code amperes for 500,000 cm. are 390, which, divided by .742, gives 526 as the constant for rubber-covered strand. A similar process will show 800 to be the constant for weather-proof strand.

It will be noted that the constants for stranded conductors are smaller than for solid ones. This is because the diameters for strands are larger, in proportion to resistance, than for solid ones.

Previous to issuance of the present code the only rule as to stranded wires that I was able to find was given in an English publication, by Mr. Stuart A. Russell, on electric light cables. Speaking of Kennelly's constant for solid wires (560) he said: "When stranded conductors are used it must be remembered that their resistance is about 28 per cent. greater than that of a solid conductor of the same length and diameter, owing to the loss of space in stranding; and therefore the formula given must be modified so as to take this into account. It is evident that the same amount of heat will be generated whether the current, C, is passed through a resistance, R, or a current $\frac{C}{\sqrt{1.28}}$ is passed through a resistance 1.28 R and therefore for stranded wires the constant 560 must be divided by $\sqrt{1.28}$, making the formula, $C = 500\, d^{\frac{3}{2}}$."

Acting upon this suggestion the writer, some years ago calculated a table for strands. Apparently English manufactur-

ers made their strands smaller in diameter than the Americans, and my constant figured 487 instead of 500. But it was questionable whether air in the inter-spaces of a strand would not so retard radiation as practically to counteract effect of larger outside surface.

Mr. Merrill's results have demonstrated that there is a counteracting influence, for the constant of 487 corrected by results of experiments becomes 434 for a limiting current of 174 amperes for No. 0000 (the old rule).

It is probable there is neither gain nor loss so far as heating effect is concerned by making conductors in concentric strands. This is corroborated by an examination of the published code. We find that a 200,000 cm. stranded conductor is allowed 200 amperes, or 1 ampere per 1,000 cm., and that a No. 0000 solid conductor of 211,600 cm. is allowed 210 amperes, or very nearly in the same ratio. There may be advantage in using the cable form; but it is doubtful.

Prof. Forbes, at one time, seriously proposed the use of flat strips for underground conductors, but he overlooked the fact that large surface means great increase in cost of insulation. In those days the wires were buried in the ground without the use of conduits, a condition very unfavorable to active convection. We can all remember that but a few years ago conduits were not ventilated except as the manhole covers, from time to time, acted automatically.

All data so far given in this paper are based upon the action of direct current. There can be no doubt but that the heating effect of alternating current, especially in large conductors, must be considerably greater than if direct current is used. But I have no information on the subject, and will not weary you with speculation.

AN ELECTRIC CURVE TRACER.[1]

BY PROF. EDWARD B. ROSA, PH. D.

ONE of the most interesting and fruitful methods of study and investigation of alternating current phenomena is the tracing of the forms and phases of alternating current waves. Without these curves one can gain only a very inadequate idea of the inner workings of a dynamo, motor or transformer. And considering the rapid multiplication of alternating current apparatus, both of single phase and multiphase varieties, it is evident that the field of usefulness of alternating current diagrams, already very great, is constantly increasing.

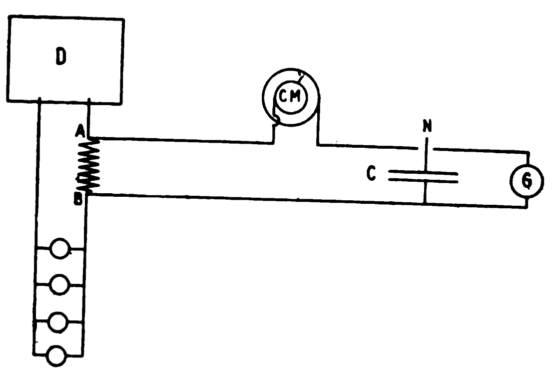


FIG. 1.

The practicability of this method of investigation and testing has been seriously limited by the great labor of obtaining the curves and the insufficient accuracy of the curves when obtained. To find and plot a dozen or two points, and then draw a smooth curve through them and call it the curve of current or e. m. f. will sometimes answer, for want of something better. But it is often unsafe to infer very much from such a curve. What is wanted is so large a number of points as to be practically equivalent to a continuous line, marking exactly the fluctuations of the current. And when several such related curves have been drawn to scale on a single sheet, showing the forms, phases and relative amplitudes of the currents and e. m. fs. (and, perhaps, also the magnetizations and power waves), which are concerned in the operation of a given machine or system, we have a beautiful picture of what in algebraic language merely is not very attractive.

Various methods of obtaining these curves have been employed. An instantaneous contact maker, connected with the armature of the dynamo, is generally used. The disc of the contact maker revolves with the same angular speed as the dynamo, and a brush which rests upon its edge makes contact once in every revolution with a knife edge let into the disc. As the brush is advanced step by step, contact is made at later instants in the phase; but while the brush is at rest in

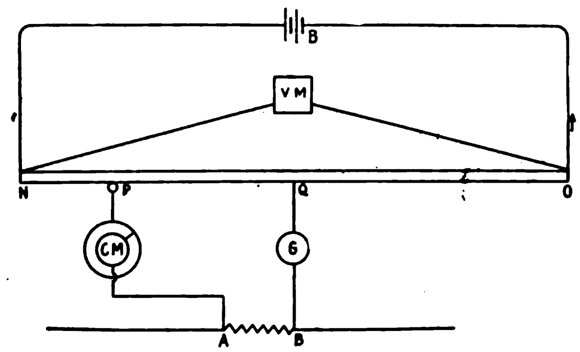


FIG. 2.

any position the current and e. m. f. return to the same value at each successive instant of contact. The value of current at the instant of contact (Fig. 1) is determined by measuring the difference of potential of the terminals, A B, of a known resistance through whch the current flows. This potential difference is sometimes ascertained by joining a condenser C, to A B by a switch N, through the contact maker M, and then discharging the condenser through a ballistic galvanometer. Under these circumstances the charge of the condenser will be proportional to the difference of potential between A and B at the instants of contact in M, and this in turn is proportional to the corresponding instantaneous value of the current flowing from the dynamo. The position of the contact brush is then advanced, the condenser is again charged and discharged, and a second value of the current, corresponding to the new phase of contact is obtained.

THE POTENTIOMETER METHOD.—In the following potentiometer method readings can be taken more rapidly as well as more accurately than by using a ballistic galvanometer or electrometer. A hard rubber rod anywhere from 60 to 100 cms. in length is wound with one layer of copper or German silver wire. A current from two or three storage cells flows through this potentiometer coil, Fig. 2, and by means of a voltmeter and adjustable resistance the difference of potential of the ends of the coil is maintained constant. The instantaneous difference of potential at the terminals of A B is now measured by matching it against the known difference of potential of a part of the coil N O. The point Q, at the middle of N O, is joined through a galvanometer to B, while P, a sliding contact, is joined through the revolving contact maker M to the point A. When the differences of potential at A B and P Q are equal there is no deflection of the galvanometer. P is therefore moved in the direction indicated by the galvanometer deflection until the latter is reduced to zero. The distance P Q is then proportional to the current through A B; and knowing the difference of potential P Q and the resistance A B we determine at once the precise value of the current. The brush of the contact maker may then be advanced, when

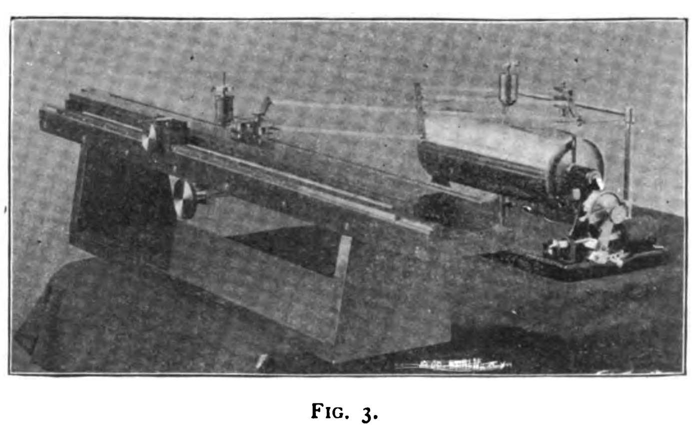


FIG. 3.

the new setting of P will give the new instantaneous value of the current A B. If, however, one undertakes to determine a large number of curves the successive settings of the brush are very tedious. The scale readings of the contact P must all

[1]Abstract of a paper read before the British Association, Toronto.

be taken and recorded, and finally after these readings have been reduced the curve is plotted out carefully by hand. One does this very willingly for a while, but if he attempts to determine accurately a considerable number of curves the work becomes a burden.

AN AUTOMATIC INSTRUMENT.—It was while engaged in this kind of work nearly two years ago that I undertook to devise an apparatus that should reduce the labor and increase the speed of drawing electric curves. The apparatus which is

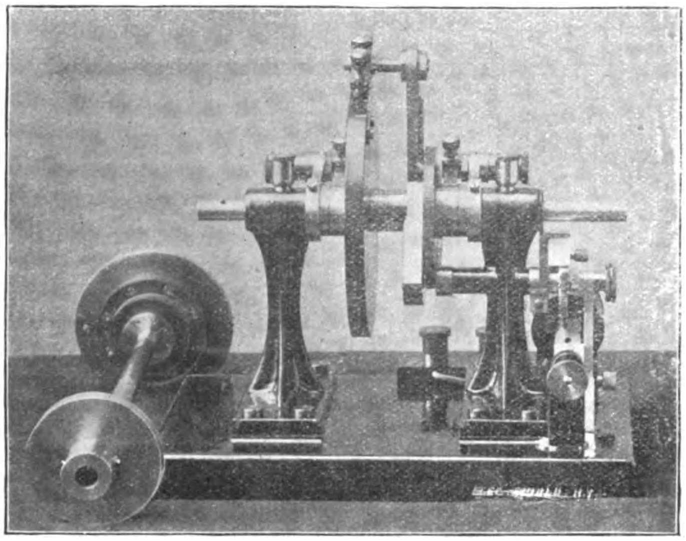


FIG. 4.

shown in Figs. 3 and 4, is the outcome of this endeavor. The most laborious parts of the operation, including setting the contact brush, are done automatically by the machine, and the work of several hours may be done in as many minutes. The measurements are made by the foregoing potentiometer method, the results are simultaneously plotted by the machine more accurately than they could be plotted by hand, and a curve being obtained in a few minutes the speed, voltage and other circumstances may be maintained more nearly constant than would be possible when the observations extend over

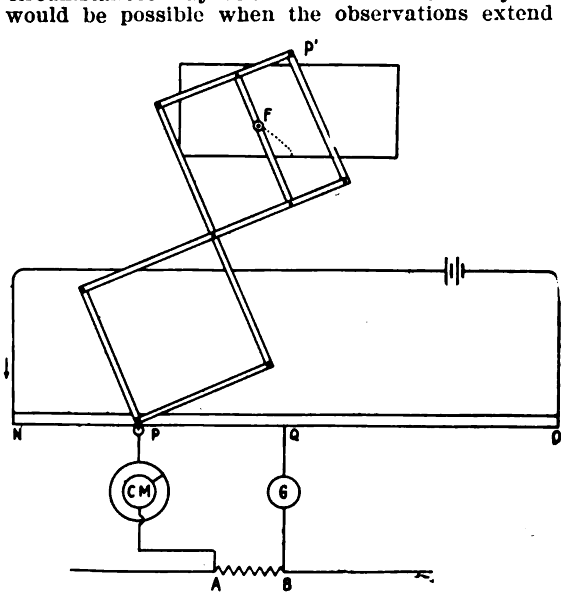


FIG. 5.

several hours. For these reasons the curves obtained are of unprecendented accuracy.

To avoid the labor of reading, recording, reducing and plotting the various values of the current and e. m. f., a pantograph is employed to print the curves automatically as the settings are made. The pantograph has one end fixed at P', Fig. 5, and the other end fixed to the carriage to which is attached the movable contact P. On an extra bar the printing electromagnet F is carried; and as the carriage and sliding contact P move to and fro along the spiral, F moves to and fro in a parallel line, at a reduced speed. The distance of F from its zero position is therefore always proportional to P Q; that is, to the value of the current at the instants of contact. Hence by printing a point directly under F upon a sheet of paper carried by a cylinder or plate the instantaneous value of the current is permanently registered. This is done by closing a key, when an electric current passes through F and throws a steel point down upon a typewriter ribbon, printing a dot on the paper beneath it. This current also passes through an electromagnet on the contact maker and another on the record cylinder, attracting their armatures against the stop pins (see Figs. 3 and 4). When the key is released and the current broken these armatures are drawn back into their former positions by springs, and at the same time a pawl on each engages a ratchet wheel and advances it one or more teeth, according to the position of its stop pin. Thus, closing the circuit prints a point upon a sheet of cross-section paper, which permanently records the value of the current. Breaking the circuit an instant later causes the brush and cylinder to advance ready for a new setting of P and another point on the paper.

DRAWING THE CURVES.—The galvanometer used is a quick dead-beat D'Arsonval, and settings are made rapidly. The carriage, to which the sliding contact and pantograph are attached, is moved to and fro by a cord which passes over pulleys at the ends, and is wound over a drum underneath the potentiometer coil. This drum is turned by a milled head, shown in the engraving. The observer keeps his eye fixed upon the galvanometer scale. With his left hand he turns the milled head, and so adjusts the sliding contact; with his right he works the contact key. As soon as the latter is opened the brush advances, and the spot of light

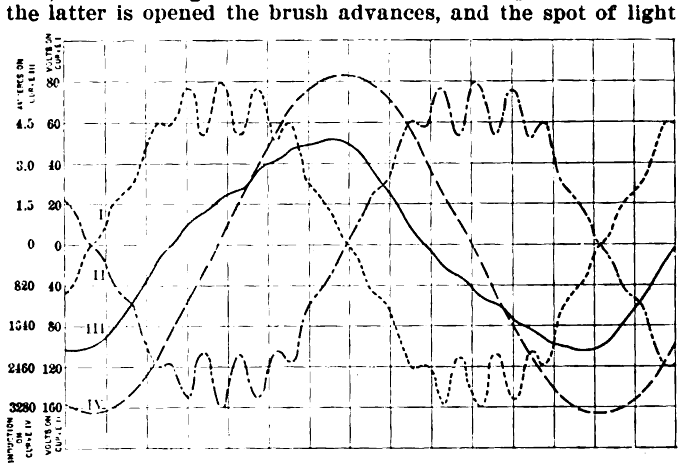


FIG. 6.

on the scale goes off the zero, to the right or left, according as the current has decreased or increased. The contact, P. is immediately moved in the same direction until the spot of light is brought back to zero, when the circuit is again closed, a point is printed, the brush advances, the spot of light again goes off the zero, etc. Twenty points a minute can be printed after some practice.

THE CONTACT MAKER.—Much of the success of the curve tracer depends upon the contact maker, and great care has been taken in perfecting it. The shaft of the contact maker is joined to the shaft of the dynamo (or perhaps to a synchronous motor) by a coupling shown in the figure. At the nearer end of the connecting rod the latter is jointed to the plate which latter is fastened rigidly to the shaft by a collar and set screw, as shown, by a flexible steel diaphram, so that perfect alignment of the contact maker and dynamo is not necessary. At the further end the plate carries two steel pins, one at its center and one near its edge, which fit loosely into two corresponding holes in a plate clamped to the end of the dynamo shaft. Thus the end play of the armature is not communicated to the contact maker, and when the latter is clamped to a firm base the shaking and jarring of the dynamo are not transmitted to the contact maker. Two oil hard rubber disc runs as smoothly as a top, hour after hour if desired, with very little attention.

The galvanometer current, which flows momentarily when the knife edge in the hard rubber disc passes under the contact brush, enters at the binding post, which is seen behind the left-hand oil cup, passes through a brush to a slip ring on the left of a large disc, and from there to a steel knife edge or contact piece let into the edge of the hard-rubber disc. Passing to the brush and insulated brush holder the current flows to a second slip ring, and away by a second brush and binding post on the right. The mechanism which

advances the brush can be understood by comparing Figs. 3 and 4. The teeth of the ratchet and large gear are numbered, so that the initial position of the brush can be recorded, and the brush returned to the same position for the beginning of successive curves. The milled head on the end of the spindle which carries the ratchet wheel and pinion enables one to set the brush quickly by hand at any desired place. The two binding posts seen at the back of the base are the terminals of the coil of the electromagnet which operates the ratchet.

Fig. 6 gives several curves taken from a transformer joined to a small Westinghouse alternator. A condenser is also joined to the dynamo and its capacity varied until there is resonance with the upper harmonics. The armature reaction is then such as to increase the amplitude of these upper harmonies. In other words, the armature reaction of the condenser current augments the tufting due to the armature teeth, and the ripples are of increased amplitude both in the primary and secondary circuits of the transformer.

Curve III. is the primary current, the secondary circuit being open. The ripples along its up-slope show the effects of the upper harmonics of the e. m. f. The beautiful work of the instrument is well illustrated here. Under each "valley" of the e. m. f. wave is a corresponding depression in the magnetizing current. A displacement of a dot by its own breadth would mar the curve seriously. The dots are so accurately placed by the instrument that a magnifying glass is used in reading off the values of the ordinates of the curves when about to analyze for the harmonic components.

Curve IV. represents the magnetic induction in the iron. The minute accuracy of the original curves is not apparent from the accompanying reproduction on a smaller scale. Along the sode of curve IV. ripples appear in the original, which are the cause of the larger ripples of curve II.

The curve tracer is being manufactured by Messrs. E. G. Willyoung & Co., of Philadelphia, and Messrs. Elliott Bros., of London. The arrangement of the record sheet has been altered, a flat table being substituted for the cylinder. This makes the instrument more compact and also more convenient.

MECHANICAL

EXHAUST STEAM FOR HEATING.

BY LE CHAT.

STEAM heating, by means of exhaust steam in conjunction with electric lighting, however economical when properly done, is more frequently than not the most expensive possible way to accomplish the end in view; this is to say, if the exhaust steam is forced through the heating system by the steam engine at the expense of a large percentage of the power of the engine itself, then we may conclude that the steam engine is employed as a heater and as such it comes nearer to being a flat failure than does perpetual motion; because, while perpetual motion is impossible, at the same time it has one good point, viz., one must ultimately reach the end and stop the expense thereby. But the "rotary steam heater" (steam engine) being partially successful, becomes an everlasting expense.

To more clearly illustrate the point it may be assumed that a 12x12-inch engine at 300 revolutions per minute and 80 pounds per square inch initial steam pressure (one-quarter cutoff) will indicate at a rate of 100 i. h. p. without back pressure (atmosphere excepted, condensation to the contrary), which engine will then be doing work with a view to furnishing power only. Now let us assmue that the exhaust pipe be "corked up," thereby diverting the course of the exhaust steam into the heating system, thus causing a back pressure of, say, 12.2 pounds per square inch, or 25 per cent. of the mean effective pressure; or, in better language, 25 per cent. of the power of the engine is employed to pump the steam into the heating system. That is to say, in addition to the cost of generating 25 per cent. of all the steam for the purpose of heating, 25 per cent. of all the power is required to pump it into the heating system, thereby straining the engine and the owner's pocketbook alike.

It might be said that this is a triple plated illustration, but in answer to this the writer begs to say that he has seen that amount of back pressure on more than one engine and upon one in particular within the last few days, notwithstanding the fact that "the sun still shines upon two sides of the street," so that it is impossible to conceive what will happen when "molasses commences to run slow."

It is also worthy of mention that some of these systems employ a "tea pot" for a feed water heater for fear that a little of the heat in the exhaust steam might be absorbed by the feed water before it is "pumped" into the steam heating system. In any case the plant above referred to had a little iron pot (which looked like a tea pot) securely strapped into position, to keep it from floating away no doubt, which some wag dubbed a "feed water boiler." As for the feed water itself, it reaches the boiler in its original package of shivers and causes the usual harvest of undue strain and overdue coal bills.

In short, in this instance to generate 120 amperes of current at 120 volts, or 19.3 e. h. p., required the undivided effort of 2,400 pounds of coal in ten hours, thus requiring 12.4 pounds of coal per e. h. p. hour, compensated for in a measure (sic) by the fact that steam heat was secured free of all expense (sic), the character of which being such as to make the radiators ashamed to look a yellow dog in the face, which, of course, they (the radiators) are never called upon to do, since no yellow dog would go into the place and take the chances of being called upon to fill a vacancy in dog heaven, through the agency of an overdose of clammy atmosphere.

It is indeed a fact that many power users are possessed with the happy faculty of thinking that in this one instance, at least, they get something (steam heat) for nothing, while on the other hand the broad grin on the face of the coal merchant remains, like the fiddler's bow, unaccounted for.

The remedy for this disease probably is one of such a nature as will necessitate infusing into the systems of deluded power users a little "horse sense" and in the end, if power users can persuade themselves to believe that a tin can of some appropriate sort, applied to the tail of the dog, will produce a better result than the steam engine as a force pump, they will have gained in sense and cents equally. In any case it does seem ridiculous to use a steam engine in place of something better when heat instead of power is required.

REDUCTION IN COST OF STEAM POWER FROM 1870 TO 1897.[1]—I.

By F. W. DEAN.

IN the year 1870 the most economical steam engine in use in mills was the Corliss simple condensing engine which used 19 or 20 pounds of steam per h. p. hour. Previous to that time compound engines had been used in England in mill practice, and simple engines had in many cases been changed to compound. In this country compound pumping engines had been used to a very limited extent, notably the Worthington direct acting duplex compound, the first one of which was put in at the Charlestown, Mass., water-works in 1863, and the installation of the Morris engine at Lowell and the Leavitt engine at Lynn are well known examples of them in the early part of the period which we are considering.

The Pawtucket pumping engine, built by George H. Corliss, and started on June 30, 1878, is another important example of economical pumping engines, and probably was the most economical steam engine which had been built up to that time, having used less than 14 pounds of dry steam per indicated horse-power per hour.

While these engines are not mill engines, they influenced the practice of builders of mill engines, and can properly be considered with them. Pumping engines have heretofore been the leaders in economy, but at present the best pumping and mill engines are practically equally economical.

Of course, the greatest single step in economy was the introduction of the compound engine.

In 1873 the most economical compound engines used about 16½ pounds of steam per indicated horse-power per hour, as shown by tests of the Lynn and Lawrence pumping engines, which then established new records for duty. Improvements in methods of using steam were made until it is now as easy to design an engine to use less than 13 pounds of feed water per horse-power per hour as it was to use as little as 16 pounds in 1875.

At this date steam jackets were common, and were used in all engines which gave the most economical performances. The steps, however, that lowered the steam consumption of compound engines from 16 pounds to 14 pounds per indicated horse-power per hour were largely the introduction of a cut-off on the low pressure cylinder and a reheating receiver between the cylinders. Although the reheater was invented by the late E. A. Cowper, of London, in 1862, so far as I know, it was first used in this country by E. D. Leavitt in his engines

[1]Presented at the New York meeting (December, 1897) of the Am. Soc. Mech. Engrs. Abstract.

for the Calumet & Hecla Mining Company, and is regarded by him as one of the most important causes of the economy of his engines.

These features appear to have been the principal means of lowering economy to 14 pounds of steam; but to what are we to attribute the step to 13 pounds? Clearance is well known to be an important factor, and its reduction, especially in the last cylinder of a series, is important for economy. It is receiving constant attention from careful designers, and its reduction is a constant source of gain.

The 13-pound mark has also been reached by an increase in steam pressure with resulting increase in the number of expansions. In some cases a reduction in the size of the high pressure cylinder has doubtless contributed toward economy, by means of which smaller surfaces are exposed to the boiler steam than would otherwise be the case. This carries with it a proportional reduction of initial condensation in the cylinder which is most prolific in this cause of waste.

Still further, the 13-pound mark has, in general, been attained by engines which have a low pressure cylinder larger for the work to be done than is commonly the case, so that the mean effective pressure referred to the low pressure cylinder is in the vicinity of 21 pounds. There are occasional exceptions, as in the case of the Louisville pumping engine, which worked with a mean effective pressure referred to the low pressure cylinder of 25 pounds. Such cases are exceptional, and their economy can be attributed to great perfection of detail.

It will in general be observed, however, whatever may be said of other causes, that most of the extreme cases of economy are those in which a good vacuum has been maintained. This leads me to say that the importance of good vacuums is often not appreciated, and that air pumps and condensers are as often too small.

There is a strong tendency nowadays to underrate steam jackets, but I believe that in every case where they have been wasteful, or where their economy is indifferent, at all events with ordinary speeds, an examination would show that the jackets are hair bound, water logged, blowing through traps, or that the jacket piping is bare, and thus steam for heating the building is charged to the engine. Such an arrangement of pipes can furnish but indifferent material for giving up latent heat to the working fluid within the cylinders, and is, in fact, absurd.

The effect of reheaters in drying out steam which issues from a preceding cylinder and in superheating it to 60 degs. or 90 degs., as is often the case, for use in the next cylinder, cannot be otherwise than advantageous, for, as Prof. Thurston shows in his paper of 1894 before this society, heat so added to the working fluid saves much more steam than was condensed to liberate this heat.

While these considerations are very general, they are necessarily so, for nobody can attribute to any one of the features named its proper effect. Moreover, their combinations are very varied.

Whatever may be said pro and con on this subject, it cannot be denied that the best results have been obtained from engines equipped with jackets and reheaters.

Considering economies effected, it is safe to say that, without including triple-expansion engines, steam economy has steadily decreased from 20 pounds to 12½ pounds per indicated horse-power between 1870 and 1897. This corresponds to a saving of $\frac{20 - 12\frac{1}{2}}{20} = 37\frac{1}{2}$ per cent.

Within this period of twenty-seven years the use of exhaust steam has extended in various mills, such as cotton, woolen, and paper mills, so that in some mills the cost of steam power is next to nothing.

Economies of this kind are not confined to the use of the exhaust of non-condensing engines, for since 1895 the writer's firm has had installed at the Washington Mills, Lawrence, Mass., a large surface condensing vertical compound engine, the rejected heat of which is utilized. In this mill large quantities of warm water are used in the dye house, which has heretofore been heated by exhaust and direct steam. Now the circulating water of the new engine is sent from the condenser to the dye house by the circulating pump at about the temperature required. In this case the rejected heat of the engine is just as effectively used up as it would be if the engine were non-condensing and sending its exhaust to the dye house. There are advantages, moreover, in the compound surface condensing engine, for there is less rejected heat to use, with consequent diminished chance for waste, and there is less heat lost by radiation from a pipe full of warm water than from one full of steam. This constitutes one of the latest forms of recent economies.

What is there to be said concerning boilers within the period that we are considering?

The horizontal return tubular boiler is still the standard of the country, and will probably so remain. It is cheap, and, if properly built, it is safe. As its tube heating surface can be effectively blown with steam with the certainty that the jet will strike every part thereof, and as, furthermore, its tubes can be effectively scraped at any time without taking the boiler out of service, it must necessarily be more economical than any of the numerous water tube boilers which are now being introduced. The fire surfaces of the latter can only be indifferently blown, and they cannot be scraped at all unless the boiler is cooled down, and in general it cannot then be done with anything approaching thoroughness.

There is scarcely any improvement to be noted in the horizontal return tubular boiler during the last twenty-seven years as far as economy is concerned, but I believe that grates have been improved to a measurable extent, resulting in an economy of perhaps 2 per cent.

My own experience teaches me that the internally fired boiler, either of the locomotive or vertical type, will save under equal conditions some 7 per cent. of coal compared with the horizontal return tubular boiler, besides causing an important economy in doing away with brickwork.

Within twenty-seven years economizers for heating feed water in smake flues have become common. Although subject to a rather large depreciation, in the general case they will save about 7 or 8 per cent. of coal.

There are economies to be obtained from the use of vertical engines. These come from reduction of friction, reduction of repairs to cylinders and pistons, and diminished cylinder oil consumption. It would not surprise me if there were a net saving of 5 per cent. by reduced friction of a vertical compound compared with a horizontal engine.

Summing up the various items that have been mentioned, the following may be presented as the economies of the period from 1870 to 1897:

Saving due to compounding, jackets, reheaters, higher pressures and greater expansions	37	per cent.
Due to vertical engines	5	" "
Due to vertical internally fired boilers	7	" "
Due to economizers	7	" "
Due to improved grates	2	" "

As these economies could not be simultaneously applied to the original condition of a mill, their sum is not a result that could have been realized in any case.

With these important economies having been brought about during twenty-seven years, the question arises, Are there any compensating disadvantages? It is easy to show that there are not.

So far the only steam engine considered is the compound engine. This engine has recently been found capable of utilizing the higher pressures much more economically than was formerly suspected. It has, therefore, diminished the advantage of the triple-expansion engine to such an extent that the latter has met with something of a setback. I believe, however, that the triple engine is still to be common when pressures begin to exceed 160 pounds of steam, and its undoubted advantage at sea gives evidence that it will be no less on land. Within a year or two an interesting and instructive comparison can be made between two pumping engines, one compound and one triple, both to use 185 pounds of steam and designed on the same lines by Mr. Leavitt.

It seems probable that the relative economies of the compound engine, using 160 pounds, and the triple, using 185 pounds of steam, are to-day represented in the very best practice by 12¼ pounds of steam and 11¼ pounds of steam, respectively, per indicated horse-power per hour. This corresponds to a saving of $\frac{12\frac{1}{4} - 11\frac{1}{4}}{12\frac{1}{4}} = 8.16$ per cent., which is a paying saving.

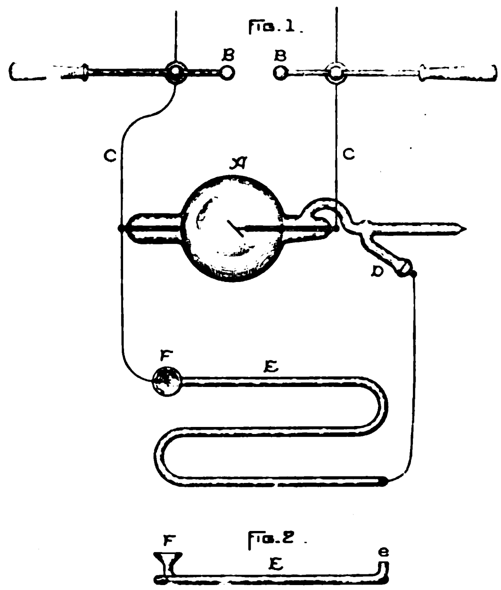
The future, so far as we can now see, offers us highly superheated steam for further means of economy. The technical papers have frequent accounts of the use of such steam in Germany, and published tests (see "Engineering," pp. 113, 391, 1895) show that a small Schmidt "motor" has used 10.17 pounds of steam per indicated horse-power per hour. It would seem that we have a right to anticipate in the early future a steam rate of 10 pounds by means of superheated steam in the best designed engines. Compared with the lowest rate thus far mentioned, this corresponds to a saving of $\frac{11\frac{1}{4} - 10}{11\frac{1}{4}} =$ 11.11 per cent.

ROENTGEN RAYS

THE RICE SELF REGULATING ROENTGEN-RAY TUBE.

It is well known that with vacuum tubes used for producing Röntgen rays a certain critical exhaustion must be maintained. It cannot be permitted to go too high, because in that case electrical resistance of the tube rises, and sparks may pass over the outside of the tube; nor can it go too low, for then, also, the rays are not generated. In the tubes first employed this was a source of considerable difficulty, and the production of the rays was more or less uncontrollable, operators simply taking advantage of the time when the screen appeared brightest.

Several devices have been contrived for controlling the vacuum, the best known of these consisting of a small extension from the tube, in which is placed a volatile salt, such as hydrate of potassium. When the vacuum rises too high, this salt may be volatilized by the application of heat, and its vapor serves to lower the vacuum in the tube. The action of this, however, is not automatic, and the judgment of the operator is necessary to make it successful. Devices have been designed also for adjusting the vacuum automatically, consist in general, in shunting a portion of the current and using it to vaporize the volatile salt in the other arrangement referred to. This shunt circuit includes, ordinarily, a spark gap designed to



FIGS. 1 AND 2.—RICE'S SELF-REGULATING ROENTGEN RAY TUBE.

offer more resistance to the current than the tube when the latter is working with normal vacuum. When the vacuum in the tube rises above normal (which is its tendency in course of working), the resistance also rises, and current crosses the spark gap in the shunt in preference to passing through the tube. The shunted current is employed to volatilize the salt either directly or indirectly, and thus the vacuum is reduced to the normal point.

The arrangements just described are a great improvement over anything previously used; but there are objections to them. Sufficient current not being conducted across the shunt quietly to effect the regulation the vacuum in the tube gradually rises until the voltage at the spark gap is sufficient to puncture the intervening layer of air. The sparks that pass are often noisy and generally annoying to the operator and the subject being examined, and they sometimes momentarily practically short circuit the tube, so that a flickering screen is produced in the fluoroscope.

Mr. Martin P. Rice, of Schenectady, N. Y., overcomes these difficulties by substituting for the spark gap a high resistance in the shunt circuit, conducting the current through it without disruptive discharges. Mr. Rice has found that for this purpose a liquid resistance was best, and the form in which he uses it is a glass tube containing water or other suitable liquid.

In the accompanying illustrations, Fig. 1 is an arrangement embodying the device, Fig. 2 being a side elevation. A is the tube; B B are the sparking terminals, and C C are line wires. D is the extension from the tube, containing a small quantity of a volatile salt, many kinds of which are well known.

E is a resistance in the shunt circuit, usually a glass tube filled with water, but any other resistance liquid may be used. At the frequencies at which these tubes are operated water is of extremely high resistance, and being always obtainable is best for the purpose. A funnel, F, is provided at one end of the tube. Mr. Rice has found that a tube three thirty-seconds of an inch inside diameter and about two feet long is a convenient size, and when filled with water affords a proper amount of resistance in the shunt circuit.

POWER TRANSMISSION

THE EXTENDED NIAGARA POWER HOUSE.

BY ORRIN E. DUNLAP.

The exterior work on the power station of the Niagara Falls Power Company has been completed, and the structure presents a truly beautiful appearance. The stone used is the same as that of the original structure, and the style of architecture is in every way precisely the same. The original section of the building was 140 feet long and the extension is 286 feet, making the total length of the building 426 feet. This length covers the entire wheel-pit and will afford room for installing the seven additional generators necessary to bring the capacity of the station up to the contemplated 50,000 h. p.,

THE GREAT NIAGARA POWER HOUSE AS LATELY EXTENDED.

which will be just one-half of the capacity of the tunnel acting as a tail race for the water from the turbines. It is evident to one viewing the building that the walls of the new section are slightly lighter than the walls of the first section, but the difference between the shades of the old and new stone is not sufficient to be noticeable in the picture herewith given, and it is quite certain that a short exposure to the elements will soon create a complete blending in the color of the old and new sections. In its new dimensions the power house is more than ever impressive of the great work of the Niagara Falls Power Company, and it stands forth prominently as a still greater monument to the benefit their work is destined to be to the industries of the United States.

TUNGSTEN STEEL FOR PERMANENT MAGNETS.

Some elaborate experiments have been carried out by C. Chistoni and G. G. de Vecchi, with a view of testing the alleged excellence of Valtrompia tungsten steel as regards permanence of magnetization and high permeability. One specimen examined contained 6.25 per cent. of tungsten, 0.99 per cent. carbon, 1 per cent. manganese, 0.19 per cent. silicon, and the rest iron. Another specimen contained 4.15 per cent. tungsten and somewhat less manganese and more carbon. Comparing their magnetizations in various fields with those obtained by Barus and Strouhal, they are certainly superior to the latter. The specific magnetic moment quoted by these authors as the maximum is 23.5, whereas the maxima obtained from the Valtrompia specimens were 47.6 and 55.6. As regards the damagnetizing influence of time, this is not felt at all except after magnetization in the strongest fields, and the authors go so far as to assert that after exposure to a comparatively weak field the magnetic moment goes on increasing independently for some time. After saturation the time required to reach a stationary condition differs in various specimens, being longer in thick rods than in thin ones. The settlement may be accelerated by repeatedly heating from 0 deg. to 70 degs.

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THE VICTORY OF THE STORAGE BATTERY.

ONE of the most encouraging features in modern central station operation, whether light or power, is the attention which is being paid to the running economies. It would be unfair to say that no attention had ever been paid to getting the last bit of energy out of the coal burnt under the boiler by some of our large operating companies; but it is certain that nine-tenths of the stations existing five years ago paid little attention to those so-called refinements which, as events frequently prove, make the difference between a dividend and a deficit. But these are the days of small things, and with them central station managers have come to understand that they can improve their balance sheet by other means than mere improvements in steam apparatus. They are gradually, but surely, coming around to the practice, long since in vogue in Germany, particularly, of operating their steam plants in connection with storage batteries. It would be a work of supererogation to rehearse at this late day all the advantages which the storage battery offers to the central station; the proof of the pudding is in the eating thereof. To carry out the metaphor, those who have tasted a good one want more, as shown by the fact that scarcely a single station has put in the battery that has not followed it up by one or more additional equipments. We are well aware that even some of the most progressive and intelligently managed companies in the country have held aloof from the storage battery, notwithstanding that New York, Boston, Brooklyn, Philadelphia and other cities had put them to good use. Among these was the Chicago Edison Company, but we are now informed that this company has also fallen into line and, if we may judge by the size of its plant just ordered, is making up for lost time with a vengeance. The Chicago Edison Company has, in fact, contracted with the Electric Storage Battery Company for a storage battery plant of no less than 7,436 k. w. hours, which is said to be the largest individual battery installation ever called for. As the battery is to be completed by March of next year it will no doubt form one of the attractions of the meeting of the National Electric Light Association to be held in Chicago next June. We might suggest that President Insull could give the members a very interesting paper on the reasons which led him to install this battery after holding off so long.

In this connection we note also the intention of the Buffalo Railway Company to install accumulators to be charged from power obtained over the high tension lines from Niagara. As their load is a fluctuating one, and is particularly low during the night the battery will be able to absorb all the surplus energy available and thus permit the company to utilize fully the power for which they are paying. This battery, we understand, will also be the largest ever installed for railway purposes. The Electrical Engineer has for a long time past endeavored to call attention to the great utility of the storage battery, even when to do so was considered heretical, and it is gratifying now to be able to note the growing popularity of this valuable station auxiliary.

AMERICAN ELECTRICAL APPARATUS ABROAD.

IT would be unbecoming for America to forget the debt of gratitude which it owes Europe for many of the great discoveries which have made this century famous. Yet, on the other hand, America has well repaid the debt by the work of its own inventors, who have reduced many of these discoveries to practical applications and thus enriched the industries of the whole world. It is in no spirit of exultation, therefore, that we express our gratification at the increasing exportation of American electrical apparatus to foreign countries and more especially to Great Britain and Europe. Thus, hard upon the announcement of a few weeks ago, that the Dublin electric railways had decided to equip with General Electric apparatus, comes the announcement last week that Glasgow had decided to equip its seventy miles of tramways with Westinghouse railway material. In this issue also we describe the electric launch now building for the Czar of Russia at the works of the Electric Launch Company, in New York. In spite of the fact, also, that Germany has made tremendous strides in the manufacture of railway material during the past few years, American apparatus finds a ready market there, while in France, for example, nearly one-half of the twenty-four roads operating electrically at the beginning of this year were using Thomson-Houston equipments.

To Americans who for years have had dinned into their ears the cry that we could not compete with foreign cheap labor this continued demand for America's electrical product abroad is of more than passing moment. Granted, what is undoubtedly the fact, that our labor is dearer than that abroad, the possibility of selling American electrical goods in European markets indicates that there must be other economies or advantages in our methods of manufacture which more than offset the labor account. And no one who has had an opportunity of passing through America's great electrical shops can fail to observe this. The fact is that machine work has been applied to the very smallest detail of dynamo and motor manufacture, and frequently of so automatic a character that a single attendant is capable of taking care of half a dozen machines. The processes have simply been reduced to a maximum of machine work and a minimum of hand labor. Europe is struggling hard against this régime but, looking at the subject from all sides we can see but one outcome to the ordeal. Indeed, the great machinists' strike now on in England is based in part on the protest of the labor unions against the introduction and full utilization of automatic tools. In this connection we might also recall the difficulties experienced by Mr. H. S. Maxim in his gun works owing to the introduction of automatic machinery. We must confess to our sympathy with men who find their usefulness and earning capacity at the start curtailed by the introduction of machinery; but, in the progress of the world, individuals have always figured as negligible factors—indeed, there can be no progress without some putting aside of old methods or material and a readjustment of men. The law of compensation comes in here, but, unfortunately, it leaves some people temporarily disappointed.

Will America be able to hold its own indefinitely in electrical work? What will be the conditions when Europe takes a leaf from our book and adopts our methods of manufacture? These are questions of great moment to our own manufacturers and few critics would assume to answer them authoritatively. But there are certain factors involved in this matter which would seem to make America's continued hold on foreign business, if not absolutely certain, at least highly probable. Thus, if it be assumed, and the assumption is a fair one, that Europe will in time adopt our machine methods, so that the cost of labor on both sides of the Atlantic approaches to equality, the case will then resolve itself into a mere matter of competition based on the cost of the raw materials and the cost of motive power to drive the tools. Viewed from this standpoint America can certainly hold its own with the rest of the world. Our copper mines are inexhaustible; our iron and steel are without limit; we are suffering from an overproduction of cotton, and as to coal for motive power we are conditioned probably more favorably than any country in the world of like extent, not to speak of our water powers. Here are facts and figures which cannot be brushed aside lightly. They certainly indicate the opportunities open to our electrical manufacturers if all the favorable conditions are fully taken advantage of. With proper design of machines so as to secure economy in material and cheapness

in machine work required, there ought to be nothing to stand in the way of our retaining our hold on the foreign markets already ours and of extending them to other fields.

This Glasgow order has other points of suggestion also. If one American firm alone had won these big contracts, it might have been put down to singular individual merit; but when we see the Westinghouse, Walker, Sprague and General Electric companies all sharing handsomely in this trade, and when we see other electrical lines also in demand for export, the only conclusion possible is that the average quality of American electrical output is very high and that the prices this country can sell at profitably are below those of the rest of the world. Long may such conditions continue!

THE BICYCLE VERSUS TROLLEY DIVIDENDS.

THAT the habit of bicycling tends to cut down the use of street cars has long been known, and occasional estimates have appeared as to the loss of revenue thus inflicted on trolley companies. The subject has just been specifically investigated by Major I. B. Brown, chief of the Bureau of Railways of Pennsylvania, who had noted a general falling off in the income of street railroads throughout the State. "It cannot be assumed," he says, "that this decrease in revenues is due to the depressed condition that has existed the past few years, as on all sides there are signs of improvement that ought to have swollen the receipts of the street railways from operations. The cause must, therefore, be attributed to something else. In all probability the use of the bicycle by business people and pleasure seekers is the prolific source of the reduction in the receipts of many street railway companies. In cities where favorable conditions do not exist for the use of the bicycle—where the hills are steep and not easy of ascent or descent—the railway companies have probably not been affected by the use of the wheel to so great an extent; but in cities like Harrisburg and many others it cannot be gainsaid that the bicycle has become a most serious competitor of the railway. The fact remains, however, that many more persons travel the streets of Harrisburg, for instance, on bicycles than patronize the cars."

As proof of this view, he cites figures from observations made in Harrisburg during October, on two days by no means favorable to wheeling. The time daily was from 7 a. m. to 6 p. m. During that period 6,078 persons passed a given point, of whom 1,962 were in the cars and 4,115 were riding bicycles. We must confess that the showing is a bad one, on the surface, but October is rather a favorite month for bicycling and, on the other hand, it is well known that the street railways even more than steam roads reflect average conditions of prosperity, so that two days next October or in normally active seasons of trade and industry might find a large precentage of increase in the patronage of the cars.

There is one moral in such figures, anyhow, and that is, to develope new traffic and to cultivate the wheelmen. Not so long ago, the Long Island Railroad Company turned a cold shoulder to the bicyclists; at the present time, the railroad is with intelligent enterprise pushing for all the bicycling trade that can be got and is diligently advertising the Island in special literature as a cyclist's paradise.

"KINDNESS ALWAYS PAYS."

ONE of the troublesome features of wiring is that of getting wires across the spaces between floors and the ceilings beneath, and sometimes very elaborate "fishing" is necessary. A veracious story which reached us from Maine indicates two things, namely, the availability of the domestic cat and the value of kindness. It was an Augusta youth whose mother had given him permission to have an electric light in his room if he would put in his own wiring, who bethought himself of a pet cat, which was greatly devoted to him, and would answer readily to his call. A good stout string was attached to kitty's tail, and she was put between the floorings and called through from one room to the other. With the aid of this string the wires were soon in place. If the boy had been in the habit of kicking and abusing that cat he never could have got her through. He might have put her under the floor and attempted to drive her, but she would only have crawled into a corner to hide. Dogs and ferrets have been tried for "fishing" in subways, but here is a new proposition. It may be remembered that when Mr. Edison started out on his electrical career, he tried to utilize a cat as battery power, in circuit with some stope-pipe wire. The battery went incontinently on strike, but it is not to be inferred that Mr. Edison as a boy was unkind to cats. He wasn't.

HOW TO INCREASE POLICE EFFICIENCY.

THE handling of a large police force throughout such a city as New York presents many serious problems, not a few of which come from the unceasing tendency to load new duties upon the guardians of the peace. It is evident that the ability of the central authorities to keep in close touch with all the members of the force while on duty, goes to the root of the subject; and how to attain this has long been the aim of police chiefs, inventors and others. Various systems and plans have been devised, and, very properly those resorted to or proposed of later years have been based quite extensively on the use of the telephone. We doubt, however, whether anyone has thought so far along this line or has pushed the idea to such an excellent practical point as Mr. John McCullagh, the Chief of Police, of New York City. Through his courtesy we are able to present his proposed plan in this issue. What strikes us most of all is that not only the department, but the public, under this system, would be able to find an officer at any moment and for any emergency. To-day that is simply impossible. That a policeman can never be found when wanted, is a belief so deeply rooted in the public mind that it has become axiomatic. It is certain that under the McCullagh system, that reproach would at once die out, and that the public security and freedom from exposure to crime would be enhanced to a remarkable degree.

We are not able to express an opinion on the conditions that apply to such a plan, and might involve adverse criticism within the Police Department; but, speaking as part of the public, and as those who are familiar with many-sided utilization of the telephone, we venture to hope that an early trial of the McCullagh plan will be adopted. If it is at all successful, other cities will assuredly follow New York's example. The criminal who could break through Mr. McCullagh's city trochas must be exceptionally smart.

THE INDIANAPOLIS THREE-CENT FARE CASE.

AS we go to press, the news comes that the United States Circuit Court of Appeals has handed down an opinion in the Indianapolis three-cent car fare case, dismissing the appeal of the city of Indianapolis from the order of Judge Showalter enjoining the enforcement of the three-cent fare ordinance. The case was one in which the Central Trust Company, of New York, in a bill filed in the Federal Court at Indianapolis, asked for an injunction retraining the enforcement of the Three-Cent Fare act passed by the Legislature of Indiana last March. The trust company is the mortgagee for a three-million-dollar bond issue of the Indianapolis street car lines. The court holds, in effect, that as the Indianapolis Street Car Company was created or formed under general laws in Indiana, amendment providing for a three-cent fare can be effected only by a general law applicable alike to all similar corporations throughout the State.

It is likely that the case may be revived again, but we are glad to see that companies have some protection against the bad faith of public authorities, and against the constant discrimination which picks out first one set of companies and then another for "strikes" of different descriptions, or for blows from officials courting popularity at the expense of anybody but themselves. If stability as popular investments is to be given to street railway properties and central lighting plants, they must be protected by uniform laws and against predatory ordinances.

"STEALING SWITCHES."

ONE of the worst practices in interurban trolley work, now so rapidly extending, is the desire of the motorman to make up time if he happens to lose it en route, and his propensity to "steal switches" so that he can reinstate his car in its proper position on the schedule. The recent bad accident on the Detroit and Oakland road appears to be something of this kind, sacrificing life and injuring limb. Cars cannot come together head on if a good train dispatching system is in use, and its rules are adhered to; and it is not going too far to say that such deplorable accidents are easily and entirely within prevention. If a motorman gets his orders and repeats them back to the dispatcher, the responsibility is at once fixed. We do not see why long trolley roads should be exempt from the precautions that experience has shown to be necessary on steam roads under corresponding conditions. The steam school is a place where interurban trolley managers can learn many good lessons.

MUNICIPAL AFFAIRS

THE GLASGOW TELEPHONE INQUIRY.

FROM AN ENGLISH CORRESPONDENT.

IF the public of Great Britain is not fully informed by this time on the peculiarities of the telephone business, it is not through lack of open discussion of the subject. At intervals of about two years, the chronic discontent and suspicion with which people are inclined to view the operation of the telephone service come to a head at some point or other of the United Kingdom. The outburst is an orchestral effect of which the principal motive is an official inquiry accompanied by column letters in the daily papers and by sage remarks in a minor key in technical journals whose editors never venture into a telephone exchange nor get closer to the subject than the outside of their own telephones. The trail of the serpent lies over it all—the horrid word "monopoly" has the enraging effect on the man in the street that certain signals have on the telegraph operator of any tongue or clime, and it is the man in the street, or his representative who talks loudest at County Council or Corporation meetings, writes the longest letters to the papers and gets off the greatest amount of nonsense in the witness box. But the word monopoly covers a mass of ignorance and as long as monopoly is said or written often enough everything else goes, and argument or facts are at a discount.

All this was observable in the discussion on the Telegraph bill of 1892, which cemented the working agreement between the Post Office and the National Telephone Company, under which the former took over all the trunk line business and the latter confined its operations to local areas; in the controversy that raged around the launching of the New Telephone Company; and in the proceedings of the Telephone Committee of 1895, which sat thirteen days, heard thirty-six witnesses, listened to evidence covering 350 foolscap printed pages—and left the subject precisely where it found it.

The report of the learned Commissioner who presided over the Glasgow Enquiry has not yet been made public, so it is a little soon to say that history repeats itself entirely, but the evidence as a whole bears a striking family resemblance to all previous discussion of the telephone question in Great Britain. Summed up in a few words, the plaint of the discontented witnesses was, "It is a monopoly, that's all we know; give us a change; deal it a blow."

Glasgow is in a chronic state of wanting something to play with. So far it has succeeded in gathering into the Corporation playground most of the public services that advanced socialism deems fit objects for municipal ingenuity to expend itself on. Water, gas, electric lighting, public baths, tramways, are all Corporation affairs, but the telephone service, being beyond the reach of arbitrary appropriation, has not yet been captured. With true Scotch tenacity the Corporation wants most that which it cannot get. Every one is familiar with the advertising cartoon of which the principal features are a small boy in a bath, a piece of soap on the floor, and an angry and baffled expression on the face of the small boy. Substitute for the piece of soap a telephone set, put Bailie Chisholm in the bath—with the same expression—and you have an accurate representation of the views the Glasgow Corporation have held on the telephone question for some years past. Whether, however, the Glasgow Corporation would be happy when they did get it—on the terms proposed in the recent enquiry—is open to considerable doubt.

The Glasgow Corporation has made numerous applications by letter and deputation to the Postmaster General for a license to establish a telephone exchange. The first application was made in 1893, and it has been renewed at intervals. The Postmaster General, being in the position of an expert and able to appreciate the inexpediency of duplicating the telephone system of a large city, has always declined to grant the license. Glasgow has not budged from its position, has maintained the "won't be happy" attitude most consistently, has refused to allow the Telephone Company to put down underground wires, with a view to improving the service, and, finally, succeeded in getting its case looked into by a Commissioner appointed by the Treasury.

The enquiry lasted eleven days, the sittings opening on the 28th of September and closing on the evening of the 9th of October. The instructions issued by the Treasury to the Commissioner, Sheriff Andrew Jameson, of the County of Perthshire, were brief and clear. The questions to which the Commissioner was invited to direct his attention were as follows:

1. Is the service, as far as it goes, efficient?
2. Is it adequate? That is to say, are all the inhabitants who desire to join the Exchange system afforded facilities for doing so without undue conditions as to wayleaves or otherwise and is there a sufficient number of Call offices (American: pay-stations) to meet the reasonable requirements of the public.
3. Is the price charged for the service reasonable?

If there is either inefficiency or inadequacy in the service, or if the price charged for the service is too high, you will endeavor to ascertain whether, and how far this is due to any refusal of facilities on the part of the Municipal or other local authorities or the inhabitants. You will also consider how far such refusal is reasonable, or justifiable on grounds of policy or otherwise, and whether it is expedient to grant the Corporation a license to establish and carry on a Telephone Exchange of its own either immediately or in the future.

There were three parties to the case. The Glasgow Corporation and a committee of "dissatisfied subscribers" were the prosecution and the National Telephone Company the defense. Each was represented by counsel; the Corporation by Mr. E. T. Salvesen; the dissatisfied subscribers by Mr. Alexander Ure, Q. C., M. P., and the National Company, by Mr. Alexander Asher, Q. C., M. P., dean of the Faculty of the Scotch bar; Mr. J. B. Balfour, Q. C., M. P., formerly Secretary for Scotland, and Mr. Charles Scott-Dickson, Q. C., Solicitor General for Scotland. The evidence of the witnesses for the committee of dissatisfied subscribers and for the Corporation occupied seven days, that of the witnesses for the company three days, and the eleventh and last day of the Enquiry was given up to the closing speeches of the three counsel. The idea of splitting the attack on the company into two columns by organizing a committee of "dissatisfied subscribers" to present a case in addition to that of the Corporation, while ingenious enough as making a showing of force, was productive of vast waste of time, as witness after witness was called to reiterate the complaints that are familiar to telephone managers the world over. We learned that the subscribers in Glasgow—just like the subscribers in New York, Berlin, Paris, or even Stockholm, the Arcadia of telephony—find that numbers they call for are "busy," and resent it with incredulity, that they occasionally get "cut off," that they get cross-talk—in Glasgow it is evidently very cross—and that they are occasionally the victims of other slips on the part of the apparatus, the operators and the subscribers themselves. It took thirty-five witnesses, whose evidence occupied the best part of three days, to place the views of the service held by the dissatisfied subscribers before the Commissioner. The witnesses generally thought that the rate was too high, and that the service was inefficient. The rate in Glasgow is £10 ($50) a year for a single station with unlimited use, and a second station or any number beyond the first may be had at a discount of 15 per cent., or for $42.50 a year. Not startlingly dear for a city of 800,000 inhabitants and for unlimited use of the service.

On cross-examination the dissatisfied subscribers almost without exception admitted that they had used the service for years, some since it was first started; that they used it very largely, and most of them considered that it was practically indispensable. When asked to give estimates of their use of the service the witnesses ranged from twenty calls a day up to keeping the telephone in use practically throughout business hours.

The case for the Corporation occupied the next four days. Witnesses were called to show how the Corporation had resolved to agitate the telephone question and in what manner it had carried on that agitation year after year, and what it proposed to do at the present juncture if the license were granted. An astonishing procession of bailies and councillors passed through the witness box and swore to the expensiveness and inefficiency of the present service and to their ability and willingness to provide cheap and efficient service if the Postmaster General would only say the word. The witnesses for the Corporation case proper numbered twenty-six in all, of whom two were experts, Mr. A. R. Bennett, the adviser to the Corporation, and Mr. H. T. Cedergren, of Stockholm. Mr. Cedergren came to Glasgow with the laudable object of explaining how they manage the telephone service cheaply in Sweden, a mission in which he was somewhat handicapped by having to talk through an interpreter.

The evidence of the bailies and town councillors was chiefly directed to show that the Corporation took up the telephone question early in 1893, impelled thereto by what they considered an inefficient service. At this time they got estimates from an "expert" which convinced them that the Glasgow municipal area could be supplied with a good telephone service, and all provision made for maintenance and sinking fund, at a flat rate of £5 a year for unlimited service. On the strength of this they applied to the Postmaster General for a license, and later sent a deputation to urge that official to grant their request. They also endeavored to bring pressure to bear through the Scotch members of Parliament, and in all possible ways showed the earnestness of the Glasgow Corporation in its desire to start a telephone system.

On cross-examination the devastating effect of the telephone monopoly microbe on the brain of the ordinary business man, even when the brain is enclosed in a good, hard Scotch head, once more became apparent. The bailies solemnly swore to the following remarkable statements. The estimates on which the 1893 application was based provided for "telephoning" the municipal area of Glasgow alone (a few square miles) at a rate of £5 within a mile radius of the exchange, the capital cost per station being placed at £15. On this estimate the Corporation had based all their agitation up to the eve of the present enquiry. Moreover, only one member of the Corporation, or of the Telephone Committee, knew who the expert was, or had even seen the written estimates. This gentleman, the "convener" of the Telephone Committee stood sponsor for the standing of the expert and for the reliability of the estimates, and the rest of the committee took his word for it, and let it go at that. Some time before the present enquiry the convener of the Telephone Committee of 1893 left Glasgow, and with him disappeared all trace of the expert and of the estimates. And as far as the bailies could tell even the name of their adviser was as much a mystery to them as that of the Man in the Iron Mask! Then, during the very week before the present enquiry opened, a new application for a license was made, not for the municipal area of Glasgow, but for the entire post office area of Glasgow, taking in all the surrounding boroughs, and containing a territory of 150 square miles, and an estimate prepared for providing a service over this whole area at a flat rate of £5 for unlimited service and regardless of the length of the subscriber's line. This time the expert had a name, Mr. Alfred Roshing Bennett.

Mr. Bennett explained that he had made an estimate for a telephone system to serve the Glasgow Post Office area at a flat rate of £5. His plan proposed a central exchange of 5,400 lines in the city and eight small offices in the suburbs and outlying boroughs, with 434 local trunks and 153 trunks to the post office for long distance work. The distribution was to be by underground cable in the central part and overhead beyond. The whole estimate was covered by tenders (most of them dated a few days before the opening of the Enquiry and available for acceptance within thirty days), the principal switchboard, a flat multiple of 600 lines per section, being German, the subscribers' instruments Swedish, and the line construction by local firms. The total cost came out at £97,833, approximately, $487,500 for 5,200 stations, or a little under $94 a station. The working expenses were estimated at £25,688 per annum and the gross revenue at £27,550, leaving an estimated balance of £1,862 ($9,910). Mr. Bennett explained in detail his plan of distribution with 204 pair cables, terminating at distributing points, each serving a circular area with a radius of 300 yards. Besides giving evidence in support of the estimate, Mr. Bennett gave a summary of the systems and rates in various continental countries, a history of the instances of telephone competition in the United Kingdom and also indulged in a general criticism of the National Company's system in Glasgow, attributing much of the trouble complained of by subscribers to defective apparatus and plant. The effect of the estimate was rather spoilt by Mr. Bennett's admission that if the Corporation got their license he should advise the installation of a system providing for 20,000 or 25,000 subscribers, a very different thing from the system for 5,000 described in his estimate and put forward as a justification of the proposed £5 rate.

The other important witness for the Corporation was Mr. H. T. Cedergren, managing director of the Stockholm General Telephone Company, who gave a general description of the state of telephony in Stockholm. Mr. Cedergren's examination was conducted with some difficulty through an interpreter, who frequently appeared to misunderstand both question and answer. Mr. Cedergren stated that his company was started in 1883, that it had at present about 17,000 lines, metallic circuit, and that underground wires were now being introduced. The paid-up capital was £50,000, on which dividends at 8 per cent. were paid. Some subscribers pay on the message rate basis, but the majority are flat rate, with an installation charge for establishing the line and station. There is active competition with the State system, which has materially reduced the rates. On cross-examination Mr. Cedergren stated that the total capital invested in the business was £278,961 ($1,395,000), the difference of $1,144,000 between that amount and the share capital being represented by a loan of $485,000, on which interest at 4½ and 5 per cent. was paid, and sinking fund reserve, pension and other funds amounting to $910,000, on which no interest was paid. If the dividends and interest paid were spread over the whole amount invested in the business, the average rate of interest would be a little over 2½ per cent.

The remaining nine witnesses for the Corporation gave evidence of little interest. Two or three stated that they did not now use the telephone service, but would if it were cheap enough. Another had been able to install an interior telephone system for less than the estimate of the National Telephone Company, and the rest were agitators, electrical, parliamentary or county council, whose stories had all been told before in other places where people could be compelled to listen.

The case for the National Telephone Company was opened by evidence of two young lady operators, holding responsible positions in the Glasgow exchanges, who made remarkably clear and straightforward statements as to the work of operating the exchanges, the manner in which the traffic was handled and complaints attended to. They stated that it was an unheard of thing for an operator, as had been implied by various of the dissatisfied subscribers, to report a line "busy" when it was not. They also stated that the exchanges were not undermanned nor the operators overworked, and in answer to a question on this point one of these witnesses said that it was not uncommon for an operator to be driven into hysterics by the ill-temper and violent language of the Glasgow subscribers. Further testimony to the gentle ways of the user of the telephone in the second city of the empire was given by an inspector who exhibited various instruments, transmitters and receivers, which had been battered almost out of shape by the hard knocks of the impatient Glaswegian. W. E. L. Gaine, general manager of the National Company, gave extensive evidence on the history and policy of the National Telephone Company and handed in a quantity of statistics bearing on the rapid growth of the telephone systems in the large towns, the amount of traffic, and the relatively small number of complaints. He showed that the company was exposed to a variety of charges which do not bear on the continental systems with which comparison had been made, and that, with all that, the average cost of the telephone service to the user in Great Britain was about 12 cents a day, or a little over 1 cent a message. The service in Glasgow was not as good as the company would like to make it, but they had been prevented from making the improvement they had effected in other cities through the refusal of the Corporation to allow the company to put down underground wires. After long negotiations with the Corporation on this subject, the latter had made a blunt refusal. In a number of other large cities the Corporations had given their consent to the work and the company had carried it out with great benefit to the service, or was actually in process of carrying it out. A statement showing an increase of subscribers of about 12 per cent. per year for the past seven years, in each of a number of large towns showed that the service was not generally unpopular, and the highest number of complaints of all sorts per subscriber per year was about three, a very small percentage of the number of connections handled for each subscriber in a year.

Dr. John Hopkinson and Mr. Edward Langdon gave expert evidence contradicting a number of the criticisms that had been made on the Glasgow plant, and pointing out that a certain amount of disturbance necessarily occurs on grounded circuit telephone lines worked in the neighborhood of electric lighting and traction systems, the only cure for which was a metallic circuit system, such as the National Company desired to put down in Glasgow.

Mr. Dane Sinclair, engineer-in-chief to the National Telephone Company, gave evidence detailing the history of the Glasgow system and describing the various interruptions and interferences to which the overhead wires were subject. All these, which were responsible for a large proportion of the complaints, would be done away with by the establishment of an underground system. He also gave a description of the operation of the call wire system and showed that much trouble arose from the fact that the subscribers do not always work their own end of the line properly, and do not appreciate that only the answering operator who made the original connection can make the disconnection. Trouble also frequently arose from the subscriber, who originated the call, failing to call off, and thus leaving two lines apparently "busy" for an indefinite time. Mr. Sinclair also met in detail Mr. Bennett's criticisms of the Glasgow plant, and then proceeded to exhibit various samples of the Manchester Mutual plant, constructed by Mr. Bennett, which he compared with samples of the National Company's material used for the same purposes. It made a rather sorry showing, even to the non-technical observer. The Mutual switchboard was sold for £25 when the plant was taken over, and the greater part of the aerial cable plant, composed of conductors insulated with cotton and tar compound, was found to be useless. Mr. Sinclair also criticised in detail Mr. Bennett's Glasgow estimate and pointed out that it was deficient in a number of important respects.

To oppose the evidence of the dissatisfied subscribers called by the Corporation, the company called a number of witnesses who made large use of the telephone service and found it satisfactory and efficient. Some of these subscribers gave details of the amount of their daily traffic showing a very large use. On cross-examination these witnesses said they had complaints to make occasionally, as defects occurred, but a good deal of trouble was caused by the actions and impatience of other

subscribers. On the whole, they had a satisfactory and an ample service.

Mr. H. M. Mavor gave expert evidence as to his use of the telephone service and knowledge of the systems in continental and American cities; and as a steady user of the Glasgow service which he found good; he preferred the call wire system to the indicator. Mr. Herbert Laws Webb, of the New York Telephone Company, criticised Mr. Bennett's estimate as being based on the assumption that the plant provided would always be used to its full capacity, whereas the experience of all large systems was that a large percentage of spare plant must always be carried. He also pointed out that maintenance charges had been practically ignored, only £2,000 a year being allowed for over £80,000 worth of plant, and that the staff provided for was totally inadequate. At a flat rate of £5 a much greater number of subscribers might be expected and many of these would be in the outlying places, to whom a service at that rate over an area of 150 square miles would be a great bargain. This would necessitate a very different plan and estimate, as Mr. Bennett himself had admitted, with capital cost and operating expense per subscriber much larger than those given in the estimate put in.

Mr. Jamēs Staats Forbes, chairman of the National Telephone Company, was the last witness for the defense. His evidence was mainly directed to an analysis of the Stockholm accounts and of the Mutual (Manchester) Telephone Company's accounts, the only competing system that had actually been started under an estimate and plans made by Mr. Bennett. Mr. Forbes showed by detailed statements that whereas the estimated capital cost per line of the Mutual plant was put at about £15 per line, the actual cost of the plant was over £35 per line, two and one-third times as much. At the end of its short history the Mutual Company had a deficit of over £24,000. In analyzing the Stockholm accounts Mr. Forbes showed that on a working capital of £50,000, to have borrowed money and reserve funds amounting to £228,901, invested in the plant would be absolutely illegal in Great Britain and that no auditor would pass a balance sheet prepared after the Stockholm fashion.

The total number of witnesses examined for the company was twenty-three, as against sixty-one for the combined case of the Corporation and the dissatisfied subscribers. The printed copy of the evidence occupies 880 pages, with another eighty pages of the speeches of counsel who summed up the evidence that they had led, on the eleventh and last day of the Enquiry. The Commissioner was then left with the voluminous evidence and some 100 odd exhibits relating to the case to consider his report to the Treasury. Up to the present there is no news of the report.

LETTERS TO THE EDITOR

OPEN AND AIR CHAMBER RAILWAY CONDUITS COMPARED.

IN your issue of December 2 appears an article headed "Washington Trolley Conduit Operative When Flooded." With your permission, I would like to do a little comparing of results so described with results secured elsewhere with another form of conduit. The Washington conduit has a maximum inside depth of 25 inches and a maximum inside depth of some 18 inches. The air chamber conduit system described by you in your issue of July 22, 1897 (also, July 6, 1892), is but 7 x 6 inches outside measurements.

When the Washington conduit was flooded for a distance of 150 feet, the power had to be doubled to get the cars through one by one; this means a loss far exceeding 50 per cent.—that is, a loss of many horse-power. When the air chamber conduit was flooded for a distance of 175 yards, the loss, when the car was in motion, was slightly over 1 ampere at 500 volts, or slightly over two-thirds of 1 h. p. (Elec. Eng., July 22, 1897). But it has shown even better results—a loss of but 1-10 of 1 h. p. (Elek. Anz., Berlin, November 12, 1896). Again, it appears that the car on the air chamber line was stopped and started at will on the flooded portion of the track, but the like does not appear in the case of the Washington conduit.

B.

"ENCLOSED please find check for my usual subscription for the Electrical Engineer, and accept my congratulations on the continued high standard of your paper." Lewis Searing, Denver, Col., Eng. Works.

TELEPHONY AND TELEGRAPHY

AN IMPORTANT SYSTEM OF POLICE TELEPHONE SERVICE FOR NEW YORK CITY—THE McCULLAGH PLAN.

IF one wanted to mail a letter, it would be thought a preposterous performance to be compelled to hunt up and down several streets for a man going around with a bag collecting the mail haphazard, instead of being able to go to a box located permanently at a definite, well known point along the street. Under the first plan there would be endless confusion, delay and complaint; under the second plan, long since adopted by the Postoffice, the collection and transportation of the mail is infinitely expedited. Yet when it comes to the operations of the Police Force, in such a large city as New York, it is found that in matters of far graver importance than speeding a 2-cent letter the public is practically dependent upon a system analogous to that of chasing all over part of the town to catch the man with a mail bag in order to give him the letter. It has become one of the proverbial sayings of modern social life, one of the perennial sources of laughter in the press or on the stage, to remark that "a policeman can never be found when he is wanted." The implication is, of course, that the officer on duty is wanting in vigilance and ability, whereas the more assiduously the man patrols his beat the more likely he is, from the natural perversity of things, to be at the end farthest from the sudden call for his services. On the well established principle that everything comes to him who waits, the habits of a lounging policeman may well render him more accessible to a community familiar with his little weaknesses than would be an alert, aggressive officer whose movements around his beat are brisk and continuous.

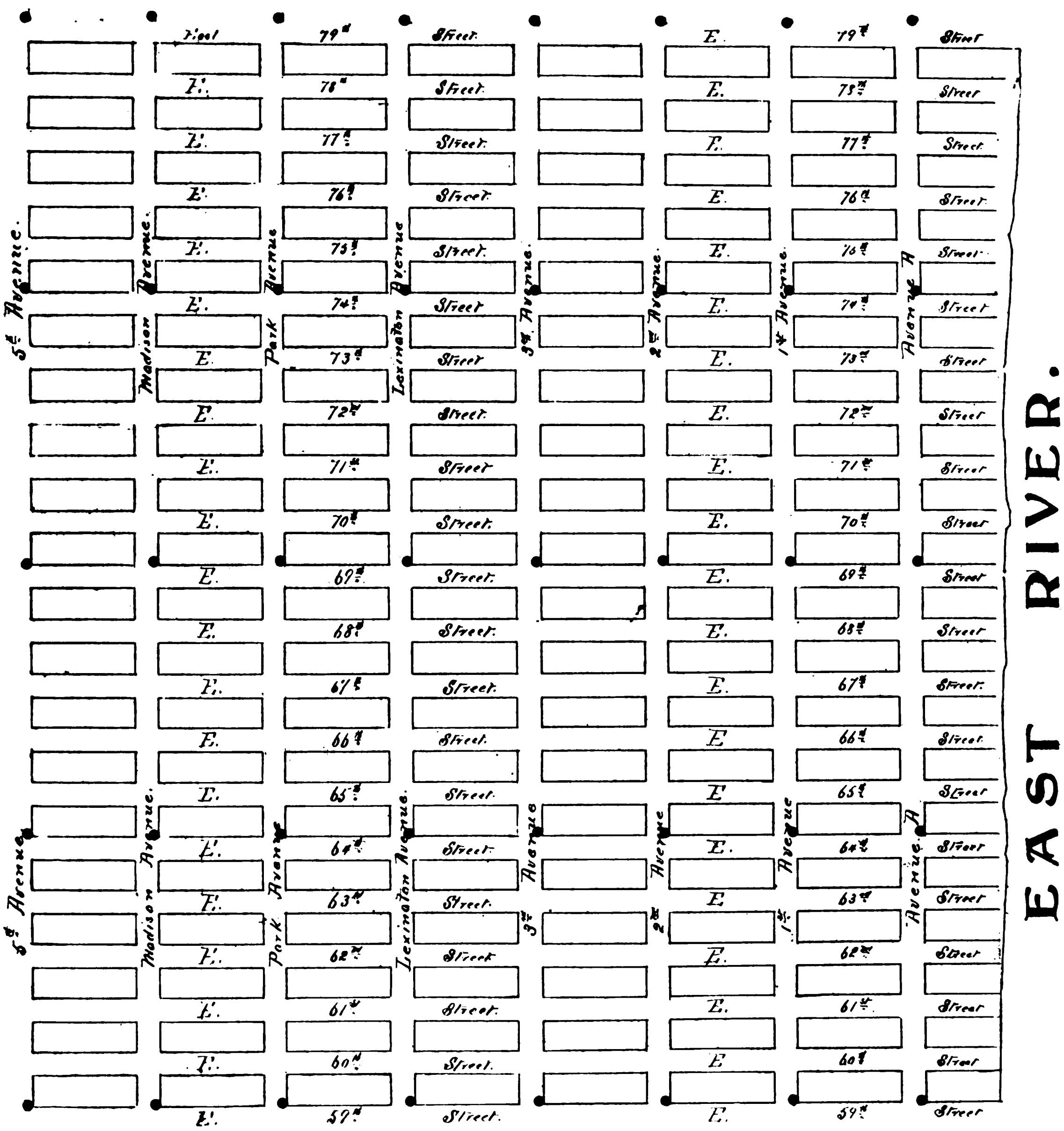
This feature of police work has always presented a serious problem to the authorities, and another element of difficulty has been that of maintaining close touch between the station house and the remote, isolated patrolman, not only to keep tab on him, but to give him command, in an emergency, of forces and appliances equal immediately to any crime or disaster. It is a well known fact that several systems of great ingenuity have been worked out with the object of affording higher cohesion and greater powers of intercommunication to a large city police force, and that resort to electricity as the agency has now become invariable. In New York City, as far back as 1889, the Police Commissioners said: "It is become a recognized necessity of efficient police service in large cities that rapid communication be had at all times between members of the force on patrol and the station house to which they are attached, not only because of the facility for better supervision of the patrolling force, but that in emergencies rapid concentration could be effected." At that time, the desirability of giving the whole of New York City something better than its very inadequate and overtaxed police telegraph system, was seriously agitated, and although some slight improvements have been seen, this great metropolis is to-day as poorly equipped for rapid police intercommunication as London apparently is for quick fire service. Other American cities, meantime, have made great headway, notably Chicago, through the efforts of Mr. J. P. Barrett, city electrician, and with the use of the telephone; but somehow the New York authorities have either neglected the question altogether, or have possibly felt that it was far too big for them to grapple with.

It is under these interesting conditions that the new Chief of Police, Mr. John McCullagh, immediately upon his induction into office, has addressed himself to the subject; and it speaks volumes for the energy and capacity of the man that he should at once lay his finger on this vital defect of the police service and insist upon its remedy if he is to be able to do his best work. More than this, Chief McCullagh during his long rise through the ranks of the service has been pondering over the problem and with nearly thirty years of ripe experience behind him has evolved a system which must commend itself to the sound judgment and common sense of the community. We understand that the Chief has memorialized the Police Commissioners on the subject, and we are now indebted to him for the data placed at our disposal in response to the inquiries we have made concerning what may be fairly called the McCullagh Method of police intercommunication. It is decidedly one of the most ingenious and practical solutions of the enormous difficulties that we have ever seen, and its adoption must assuredly mark a new era in police efficiency.

Before detailing the McCullagh plan, note may be made in passing of what we gather to be the Chief's objections to existing signal systems, useful and necessary as he concedes them to be. He desires simply to go much further. Existing signal boxes, such as may be found in outlying regions of New York, contain a telephone and an automatic signaling device, and from them reports of various kinds can be made. Obviously these show the patrolman to be at his post at definite times and seasons, and put him under direct control from headquarters, but as to what the patrolman does between whiles, there is nothing to show, especially if there be but one box to the long "post." It has also been urged that the picking up of fugitive criminals is facilitated by the ease with which the officer can be notified from the station house when he reaches the box; but Captain McCullagh seems to think this largely theoretical, while it imposes no direct responsibility on the policeman. In the same way, the placing of access keys in the hands of trusted private citizens so that they can use the boxes in emergencies is not considered adequate, for quick work, by the Chief, who says that in an average precinct it would take half an hour to get to the box, to send the message in by a flustered person, and get an officer to the spot where aid was needed.

Under the present signal system, it is true, an officer does not have to leave his post to call the station house or to summon a patrol wagon or an ambulance, but Chief McCullagh says that as an actual fact, the officer will more often than not be confronted with conditions, as things are to-day, that drive him to any handy private telephone rather than to his own faraway signal box; and thus, using a line through ordinary telephone "central" he is again subject to the inevitable chances of delay and to the great risk of the people or department he wants being "busy." The way to offset much of this would naturally be a multiplication of the signal boxes, but even then the officer would not be there except at stated intervals, and the rest of the day he must be hunted for. In the city of Chicago at the beginning of 1894, the last year for which figures are at our hand, there were no fewer than 700 signal boxes in use, and we believe the number has greatly increased since then. As a final plan adopted in New York and presumably in some other cities, a few stationary posts have been established for the day time, as on Broadway, but even in such cases the man at the beat is not in direct touch with his station house, and is more of a sentry than a picket.

Weighing all these things in his mind and many other points of police duty technique, Chief McCullagh has now recommended to the Police Commissioners that permanent stationary posts, or sub-stations, be established in each precinct, which would become as well known as the location of the corner letter boxes or the drug stores or hotels. Each of these substations is to be an ornamental iron booth, located on the main thoroughfares and from every side to be not farther than five



MAP OF TWENTY-FIFTH POLICE PRECINCT, NEW YORK.

(Black circles indicate proposed location of Police Booths.)

blocks apart. We give herewith a diagram of one of the well known precincts in the crowded central part of the city, where the McCullagh system has been worked out diagrammatically. It will be seen that each patrolman as he crosses the city on his beat from East to West traverses several lines of intercommunication, from any one of which he can be intercepted and from any one of which he is never more than two and a half blocks distant. Each of these booths, moreover, would be in constant charge of a special patrolman and be connected directly by telephone with the station house. It would be the duty of this officer on being notified by a citizen that his services were needed to inform the station house swiftly in turn, by his telephone, proceed himself at once to the scene, take the proper steps until the patrol wagon came whirling to his help, and then go back to his booth, noting the time of his departure and return. If he had himself an arrest to make, he could still do so without being away long, and even then in his absence the post would be protected until he got back from the station house.

The great fact that stands out, however, over and above all the numerous incidental advantages, is that, first of all, the public would always know where it could find an officer of the peace, at any moment, day or night; and there is the corollary that the very existence of such a sub-station in every little acre or two, would be a tremendous deterrent of crime. There would no longer be any point in watching shrewdly until the officer had got to the other end of his round and had thus given time enough for the criminals to do their deed and get away safely in spite of a possible alarm. Besides it would be easy to equip such sub-stations if needed, on the semaphoric plan, so that along the lines of the great avenues word could go and signs could flash, putting the whole force on the instantaneous alert. Houses and offices could also be connected into the police station house, if required, so that on notification the officer at the sub-station nearest could go at once to the place calling for help, without any outward evidence to the perpetrators of crime or their confederates that assistance had been summoned.

Such in brief detail is the plan upon which Chief McCullagh has been meditating for some years and which he has now laid before the Police Board, asking them, virtually, to put in a police station in every five city blocks, say from the southern tip of the island up to Washington Heights. Expense has to be considered closely, a police force being an insurance which the insured likes to see done efficiently at the lowest possible rate. But the surprising thing is that this McCullagh system, setting up some 400 we will say of these pillars of public safety throughout the city, would not require another man, owing to the ease with which the boundary lines of posts can be changed; for with so many skillful officers at points where they can always be found, the other men still patrolling can be safely allowed to extend their territory. Chief McCullagh estimates that 1,000 more men on the force would not give it as much increase of real strength and flexibility as this proposed plan. In order to put it on trial he has proposed to take the Nineteenth Police Precinct, and there set up some twelve of these new sub-stations. Mr. Brennan, the well known superintendent of New York Police Telegraphs, has estimated an expense of about $6,000 as necessary to do the work. It is of course understood that the wires will all run through the subways already in use in the precinct.

There are features of the plan which are connected with the improvement and remodeling of the Detective Bureau, that Chief McCullagh has in mind, but these would take us beyond the scope of the present article. We can only say, in conclusion, that it will be intensely interesting to everybody in this great city to see how this novel plan works out, in preventing evil, arresting criminals, assisting in cases of disaster, regulating processions or checking riots, and in general adding to the public sense of security, while silencing forever the time-worn complaint that the policeman can never be found when wanted. Chief McCullagh has our heartiest good wishes in his thoughtful and well matured scheme.

LARGE BELL TELEPHONE OUTPUT.

The statement of the American Bell Telephone Company, showing the output of instruments for the month ended November 20, is as follows: Gross output, 29,023; increase over last year, 13,838; returned, 7,817; decrease from last year, 1,256; net output, 21,206; increase, 15,094. December 21 to November 20, gross output, 214,897; increase, 39,551; returned, 84,068; decrease, 804; net output, 130,829; increase, 37,355; total outstanding on November 20, 903,118, an increase of 134,668.

THE ERIE TELEPHONE COMPANY'S Southwestern division has acquired the property of the Mutual Telephone Company, alleged to be the last of the opposition companies in Texas.

ELECTRIC TRANSPORTATION

ELECTRIC LAUNCH FOR THE CZAR OF RUSSIA.

OUR readers will recall that at the time of the great Naval Parade in New York Harbor, in 1892, the Grand Duke Alexander, in command of the Russian warships, was so pleased with the electric launch of the U. S. Cruiser "New York," that he requested the Navy Department to sell it to him for his own use. This request was granted.

The performance of this boat, built by the Electric Launch Co., of New York, came under the notice of the Czar of Russia, and the result has been that the latter, a short time ago ordered one for his own use which is now under construction at the works of the Electric Launch Co., at Morris Dock, N. Y., under the personal supervision of Mr. J. C. Chamberlain, president of the company, in connection with Capt. D. T. Mertvago, naval attaché of the Russian Legation at Washington.

DIMENSIONS AND CONSTRUCTION.

The dimensions of the gig will be as follows:

Length over all, 37 feet; length on load water line, 35 feet; beam, extreme outside of planking, 7 feet 3¾ inches; least freeboard, 2 feet 4 inches; draught at wheel, 2 feet 1 inch; draught of hull, 2 feet 3 inches; draught of skeg, 2 feet 4 inches; length of cockpit, or seating space, 14 feet 9 inches; greatest width of same, 6 feet 5 inches; distance between hoisting shackles, 19 feet; displacement, without passengers, not to exceed 5.2 tons.

Great care will be taken in the construction of the boat. The keel, kelson and stem will be of oak, the stern of hackmatack, and the frames of steam bent, seasoned white oak. The planking will be double, the inner planking of selected white cedar, copper fastened and thoroughly coated with white lead, and the outer planking of seasoned mahogany. The deck, both fore and aft, will be laid with thin strips of mahogany, blind nailed, and taking shape from the outer edge of the boat.

The main cockpit, or seating space, is to be surrounded with a coaming of quartered oak 5½ inches above the deck, and all interior finish of this cockpit will be in mahogany except the tops of the side seats, which are to be of white pine. Forward and aft there will be a small cockpit, with quartered oak coaming 4½ inches high, and large enough to accommodate one deck hand in each.

The finish of the gig will be in varnish and paint. The outside of the hull, above the waterline, all the upper works and the interior work will be handsomely polished and finished in the natural wood with spar varnish. The hull below the waterline will be painted and sheathed with brass.

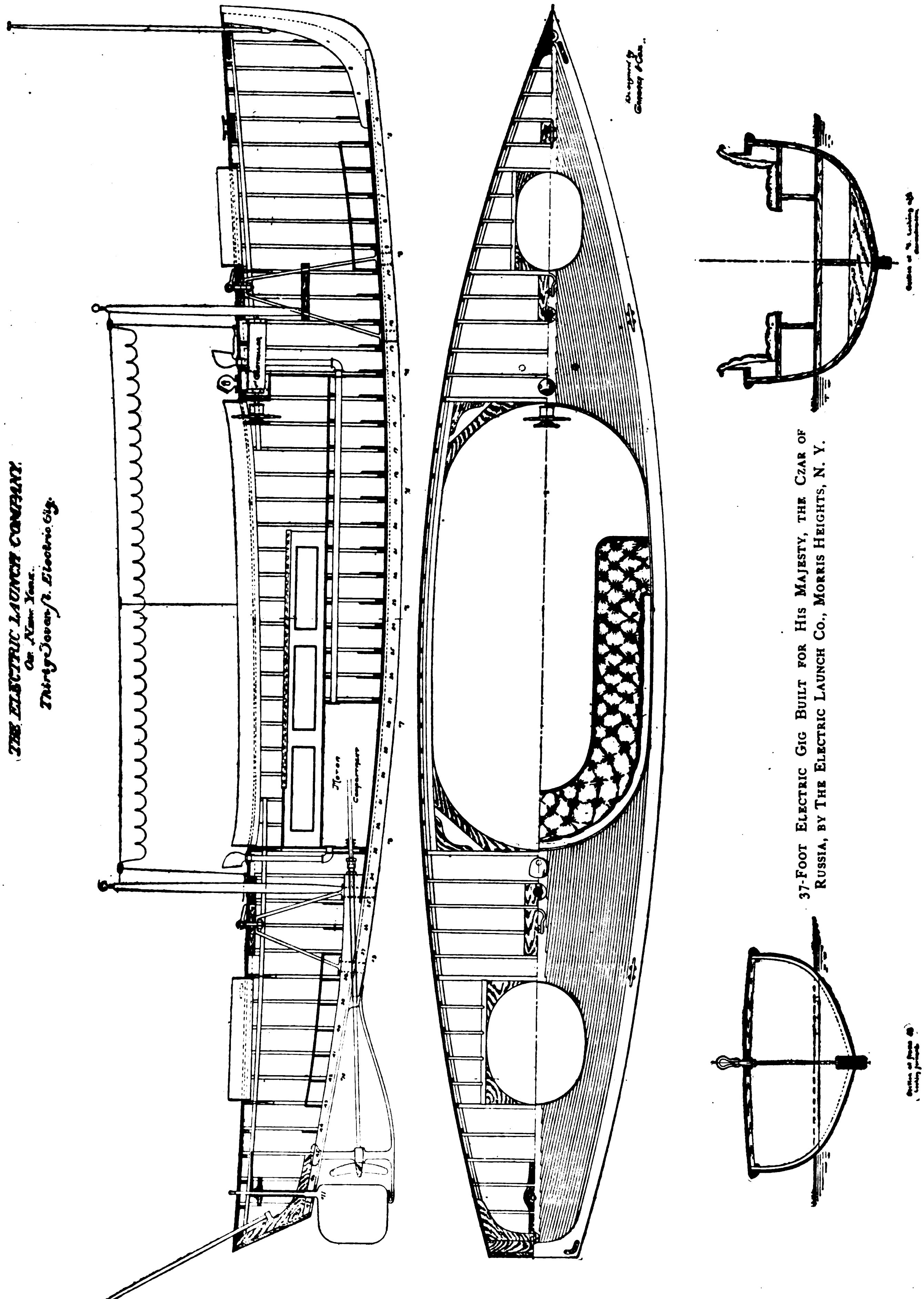
FITTINGS AND FURNISHINGS.

All the deck fittings will be in hard brass, and the exposed parts nickel plated. The stern band will also be nickel plated. The propeller shaft is to be of Tobin bronze, and the wheel will be easily removable. The rudder will be of solid brass, with a suitable brass tiller under the deck, and a rudder post extending above the deck for an adjustable tiller. The steering wheel is to be of brass, with mahogany drum and handles, and the gear is to consist of a linked chain around grooved pulleys, connected by bronze wires alongside of the boat to the rudder tiller. A duplicate wheel will be furnished.

Of the gig's furnishings, there will be a portable binnacle, three sailing lights, the side lights to fit on the coaming, and the bright light to be attachable to the forward awning pole; a galvanized iron folding anchor, with twenty-five fathoms of manila rope, one and one-half inches in circumference; coaming step of mahogany; canvas cover to fit over the decks; rubber mat for flooring over the motor and the battery hatches; velvet carpet to cover the entire floor; three wicker chairs for main seating space; linoleum mats for the flooring of the smaller cockpits, and the gig will have twenty life preserving vests.

There will be cushions upholstered in dark blue Russia leather, for the side seats and back of the seats, and pillows or cushions for the wicker chairs, and two raised ottomans of suitable design and covered with leather.

An awning of white canvas, with dark blue trimming, will be supplied, and so spread as to be under the control of the deckhand on the after cockpit, that it may be readily tilted for the convenience of the passengers, and is secured in position by running through rings on deck to suitable cleats.



37-Foot Electric Gig Built for His Majesty, the Czar of Russia, by The Electric Launch Co., Morris Heights, N. Y.

ELECTRIC POWER EQUIPMENT.

The storage batteries, furnished by the Electric Storage Battery Co., will be of the most improved and modern type, all contained in hard rubber cells, with tight fitting covers, and placed under the flooring and seats. The number and grouping will be such as to adapt them to be charged from a 110 volt circuit. The motor built to conform to the hull will be of special marine type with self-contained ball bearing thrust fitted under the floor in its compartment, and directly connected with the propeller shaft. The controller for regulating the speed of the motor will be placed under the forward deck, and operated by a shaft extending through the steering wheel bearing. This controller will be capable of effecting five variable speed rates, from slow starting to spurting speed, and also adapted for reversing the motor with three variable speeds.

The gig is to have a speed of eight miles an hour for three hours, or seven miles an hour for six hours.

The lines of the boat were furnished by Messrs. Gardner & Cox, of this city, and in rough water she is expected to be the best of her type.

It will be observed that the gig has two cockpits, one fore and one aft. These will be occupied by the attending boatmen who may, if desired, be concealed entirely from view till required for handling the boat at landings, etc.

The gig, when finished, will be put through an official test in order to determine its seaworthiness and ability. Thus, in a wind of five points and a sea of four points, the gig must be seaworthy and not heel beyond the maximum angle of stability. Also with a weight equivalent to 15 passengers, about 2,500 pounds, laid along one side of the gig, the angle of deflection shall not exceed that of maximum stability. In fact, every condition of actual service has been provided for.

The fore and aft compartments are of sufficient size so that in case of any accident to the body of the hull that would admit water, the gig would keep afloat. These compartments have watertight bulkheads, and the two cockpits have watertight covers, so that they can be battened down for a trip in rough weather. As stated above, the normal speed of the gig will be eight miles an hour, but the controller is arranged to admit of a spurting speed up to eleven miles per hour if desired.

It is perhaps needless to say that all the appointments will be most luxurious. The furnishings, such as the cushions, will be in light blue leather, to conform to those of the imperial yacht to which the gig will act as tender.

It may be worth mentioning here that the placing of the order for this gig was the result of deliberations and experiments extending over two years. It is also noteworthy that this is the first instance in which the Czar has personally empowered a representative in this country to execute a personal order for him.

The gig is to be delivered and placed in commission by the builders' representative, who is also to instruct the crew in its care and operation.

ELECTRIC STREET RAILWAYS, ST. ETIENNE, FRANCE.

Consul H. S. Brunot, of St. Etienne, sends the following to the State Department, dated October 21, 1897: I beg leave to inform the Department that several new lines of electric street railways have just been voted by the municipal council of this city. These enterprises may afford good opportunities to our electric plant builders to propose their machinery to the contractors of these lines. The names of the probable contractors are M. Cuffinhal, electric engineer, St. Etienne, and M. Buffaud, Rue Hotel de Ville, Lyons. Besides these urban lines, the surveys of two cross-country steam railways, each about 60 miles in length, have been completed and work is about to be commenced. Further, plans of a cog railway to the summit of Mount Pilal, a high mountain in this department, are being discussed. The promotor of this latter is M. Doppler, Rue Grange de l'Oeuvre, St. Etienne.

RAIL BONDING.[1]

BY WALTER E. HARRINGTON.

Each manufacturer of rail bonds states his bond is the best; the number of bonds now upon the market approximates closely about twenty different designs.

It is a difficult matter to determine which bond is the best adapted to one's conditions; what may possibly answer under certain conditions will not answer under others. The majority of bonds are designed to make lateral contact with a hole in the web of the rail; this at once defines the necessity of good, clean, uniform surface in the hole in order to insure good contact. While it may seem an easy matter to obtain good, clean, uniform surfaces, the fact is that in the majority of instances holes are not true and are full of ridges. The writer has frequently removed bonds, where it seemed as if every precaution possible had been observed to make good contact, with barely more than 10 per cent. of contact; in some instances the bonds could be readily pulled out of their holes.

Further, rails will be either punched or drilled for bonds at the mill and the holes will frequently become coated with rust before the rails are placed, resulting in either the necessity of using a file or reamer, making the holes larger than they should be. I do not wish to convey the impression that good contact cannot be made with bonds making connection through a hole in the web of the rail, as such can be done, but the frequent bad contacts upset our confidence in them.

KIND OF BOND	Center to center of contacts	Length of Bond	Size of Contact	B. & S. Gauge	Number of wires in bond	Ohms	% Res. = A/B
Joint Only—No Bond	36 inches					.00071	
Iron Channel Pin	45 "	48 inches	9/16-inch pin	0	1	.00049	69%
Bryan-Iron Wire	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	⅛ inch	2	.000286	40%
Crown	30 "	36 "	⅞-inch head	0000	1	.000247	34%
Bryan-Iron Wire (Amalgamated)	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	⅛ inch	2	.000224	32%
Crown (Amalgamated)	30 "	36 "	⅞-inch head	0000	1	.000185	26%
Bryan-Copper Wire	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	0000	2	.000175	24%
Columbia	30 "	36 "	⅞-inch head	0000	1	.000131	18%
Columbia (Amalgamated)	30 "	36 "	⅞-inch head	0000	1	.000126	17%
Stranded Crown	5 "	7 "	⅞-inch head	0000	1	.0001	14%
Plastic Socket	3½ "					.000093	13%
Bryan-Copper Wire (Amalgamated)	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	0000	2	.000071	9%
Plastic Cork	9 "		Surface 1¼ deep			.00066	8%
Solid Rail—No Joint	18 "		There were holes in web.			.000013	

TESTS MADE ON PENNA. STEEL CO. 7 INCH GIRDER RAIL, NO. 238. (A=Resistance of Bond. B=Resistance of Joint only).

The use of the Edison-Brown amalgam to improve the contacts of copper bonds showed some very interesting results. Used with the Crown bond manufactured by the Washburn & Moen Manufacturing Company, it showed a decrease of 24 per cent. in the resistance by amalgamating, whereas the Columbia bond manufactured by the John A. Roebling's Sons Company, only showed a decrease of 5 per cent. showing conclusively that the forms of contact made by the Columbia bond is far superior to the Crown; this is substantiated by the data in attached table which shows that the Columbia bond has a resistance of 53 per cent. of the Crown, neither amalgamated.

The troubles incident to making contact in a hole in the web of the rail led to the trial of the much abused Bryan bond. This bond consists of a large number of parts and is open to the objection that a bronze casting is used as part of the conductor. The bond, in brief, consists of two No. 0000 copper wires, clamped by bronze and iron castings, the bronze casting in contact with a corrugated copper washer which is in contact with a freshly made contact surface upon the face of the rail, the whole held together by a 1 inch bolt and nut with a lock washer. This bond overcomes the radical objections inherent in the type such as the Crown and Columbia, depending upon their contact with the sides of a hole. The resistance of such a bond without the Edison-Brown alloy is very high; comparing it with two Crown bonds non-amalgamated shows a resistance 146 per cent. higher, but the amalgamation makes a remarkable difference. Comparing it with the non-amalgamated Crown bond makes a difference of just 42 per cent. in favor of the Bryan (when amalgamated), whereas with two Crown bonds, amalgamated, makes a lesser difference of 23 per cent. in favor of the Bryan bond amalgamated, with a still further advantage of permanency.

The great objection to the Crown and Columbia, etc., type of bonds consists chiefly in the mechanical defects inherent in them. The vibration of the rail, with the play of the rail joint, results in a continual stress upon the small area of the contact, followed by the final loosening of the bond.

[1] A paper read before the Elect. Sect. of the Franklin Institute.

The writer has removed bonds of the above types, which had been in service only a couple of years, that had become loose and the continual movement had worn the bond approximately ⅛ inch smaller in diameter in places. The Bryan bond and those types which are flexible and particularly the Edison-Brown type are free from such mechanical defects.

While it was not the purpose of the writer to make the tests herein outlined to demonstrate the virtues of the Edison-Brown, still the results were so pronounced that especial stress is laid upon them particularly since practical experience has demonstrated their permanency. It will be noticed the "plastic cork" type of Edison-Brown bond gave the lowest resistance of any of the bonds tested.

Conclusions.—The Edison-Brown plastic cork bond is the best.

The Standard bond under fish plate is excellent, but is difficult to place.

The Bryan bond is the best round fish plate type of bond—both electrically and mechanically—provided, however, that the bond is thoroughly amalgamated with the Edison-Brown alloys.

The Crown and Columbia types of bonds would not be so objectionable if they were stranded, and the strands protected from electrolysis.

The Crown type of bond is rendered materially efficient by the use of the Edison-Brown alloys, while the Columbia type is only benefited slightly. In both instances the Columbia is the better.

Iron wire bonds are highly inefficient.

Any method of testing wherein drop in potential is measured from same contacts through which current flows to make measurements leads to false readings as the measurements include the drop in the contacts.

OBITUARY

PROF. ALONZO S. KIMBALL.

Alonzo S. Kimball, Professor of Physics at the Worcester Polytechnic Institute since 1872, died recently at his home in Worcester, Mass. He was born in Center Harbor, N. H., in 1843, and graduated at Amherst College in 1866. He established the departments of Physics and Electrical Engineering at the Polytechnic and was a lecturer for a number of years at Mt. Holyoke College. He contributed a number of valuable papers to scientific publications and to the transactions of the scientific societies, and was a member of the American Academy of Arts and Science and of the American Institute of Electrical Engineers. He leaves a widow and three children.

GARDINER G. HUBBARD.

Mr. Gardiner G. Hubbard, a director in the American Bell Telephone Company, died at Twin Oaks, his suburban residence a few miles from Washington, at an early hour last Saturday morning. His death was due to a complication of diseases and to old age.

He was of New England ancestry and was born in Boston in August, 1822. His early educational training was received in the common schools and in the Academy of Leicester, Mass. After this course of study, he taught school for a year in Piermont, N. H. He then went to Dartmouth College, where he was graduated in 1841.

In the same year he began law studies in the office of his kinsman, William J. Hubbard, in Boston. The next year he commenced a two-year course at the Harvard University Law School, and he was admitted to the bar in 1843. He immediately formed a partnership with Benjamin R. Curtis, and began the practice of law in Boston in December, 1843. He soon left the partnership, however, and practiced alone for some time. Later a partnership was formed with John M. Pinkerton. He ceased active practice of law in 1870, and in 1872, on account of delicate health, which was severely taxed by the climate of Boston, he removed to Washington. From this time to his death he kept a summer home in Cambridge, Mass., and a winter residence at Twin Oaks, near Washington.

It was about 1874 that Mr. Hubbard became interested in the telephone, through his son-in-law, Prof. A. G. Bell, and after 1878 he devoted his energies entirely to this enterprise. About that time he was also financially interested in the Edison phonograph. After the Bell system had been thoroughly introduced in this country, he went to Europe to organize companies for the establishment of the telephone in England and on the continent. He obtained concessions and organized the International, Oriental and other companies. He installed the American system throughout the Russian Empire. He was always a man of large public spirit and sympathies. Among the many interests of business and educational life with which he identified himself were the institution of a postal telegraph system by the National Government, the promotion of the railway mail transportation system, and the education of the deaf and dumb. He was appointed by President Grant a Special Commissioner on Railway Mail Transportation. He was president of the National Geographical Society, vice-president of the American Association to Promote Oral Instruction of the Deaf, and also of the American Association of Inventors and Manufacturers. He was also one of the founders of "Science." His fortune probably reached several million dollars.

PERSONAL

THOMAS A. EDISON, JR.

ELSEWHERE in these pages is illustrated a new incandescent lamp, which is being put upon the market by Mr. Edison's son, under the name of the "Edison Jr. Improved" lamp. We are glad to be able, at the same time, to present a portrait in which some of us who have trained with the "grand old man" recognize many a familiar lineament. Thomas A. Edison, Jr., was born in Newark, N. J., in 1876, and is

therefore just 21. He is like many others proud of being a graduate of the Edison University, and outside of the ordinary run of education may be said to have spent his life in the Edison laboratories. One of our contemporaries says that young Mr. Edison "recalls his father's endeavors to bring out the old tinfoil phonograph." This is not so bad, considering that the present writer when working with Mr. E. H. Johnson and Mr. S. Bergmann on that very instrument, in 1877-78, remembers the brisk little chap, then barely able to walk or speak, as he haunted the busy shops at famous Menlo Park. Precocity even in an Edison hardly goes that far. Still, young Edison has been very close to all his father's work, from those crowded days of glory right down to the recent work with the X-rays; and now that he starts out for himself, many a hearty hand of welcome will be extended to him. In other ways than facial, Mr. Edison the junior suggests the senior, such as a similarity of handwriting, a deftness with pencil which has

become skill with the brush, a keen insight into electrical and mechanical principles and an immense capacity for work.

MR. P. B. DELANY has sustained a severe loss in the destruction by fire of his beautiful residence "Killavilla" at South Orange, N. J., with part of the accumulation of many years of foreign travel and bric-a-brac hunting. The loss is put at $20,000, on which there is partial insurance. The fire is supposed to have been caused by the blowing of a lace curtain against a gas flame. Mr. Delany was living at the time in another of his houses near by, Killavilla being occupied by friends, who also lost many of their effects.

MR. CHARLES E. BIBBER, of Bibber White Company, Boston, paid a flying visit to Chicago last week.

PRESIDENT S. INSULL of the National Electric Light Association sails this week for England, on a short trip to include the Christmas holidays.

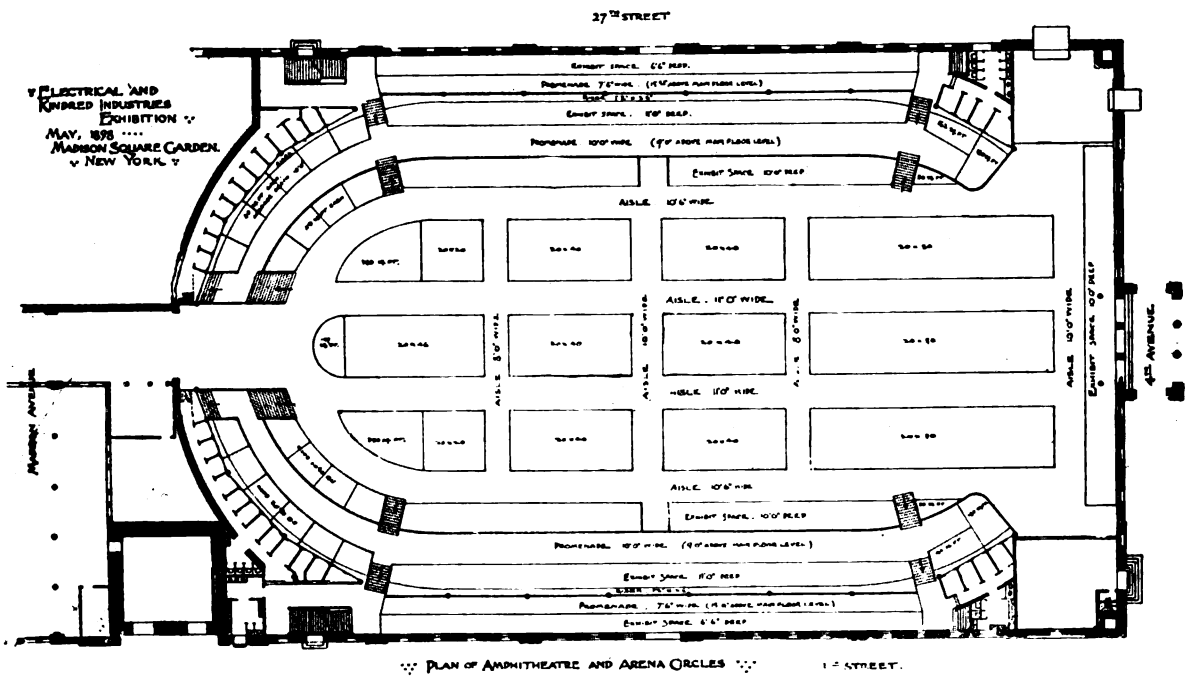
DETROIT, MICH.—The national convention of electrical workers has decided to put a memorial stone or monument over the grave at Washington, D. C., of Henry Miller, the founder of the organization. He died in 1896.

NEWS AND NOTES

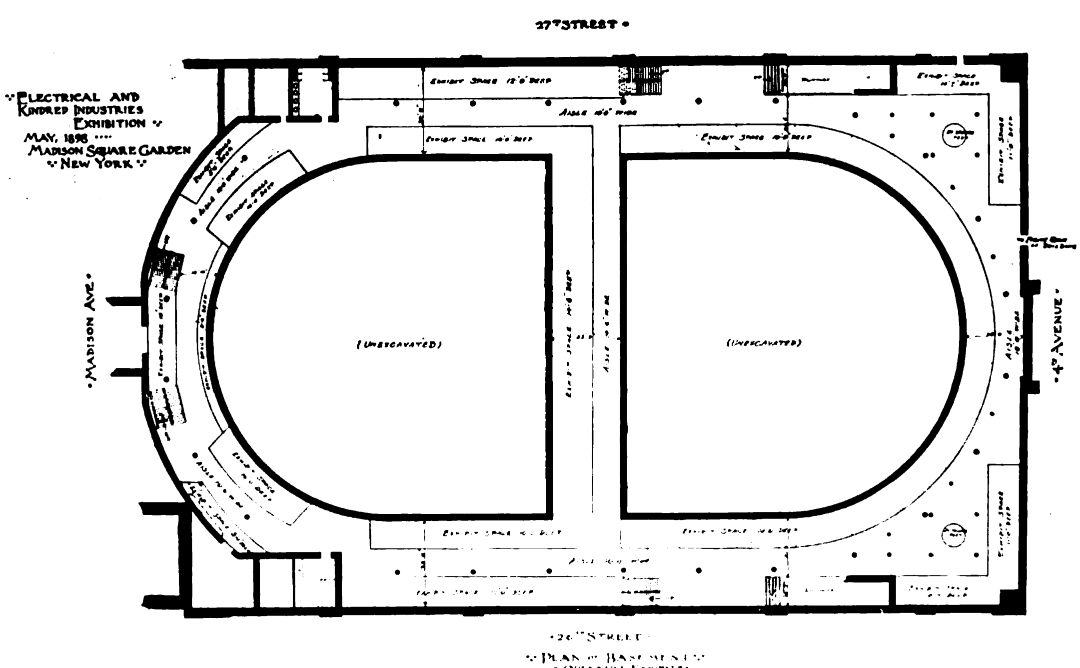
THE ELECTRICAL EXHIBITION IN NEW YORK CITY.

EVENTS move quickly nowadays, and, although it is but a few weeks since the Electrical Exhibition Company made its announcements for the show of 1898 at Madison Square Garden, a surprisingly large amount of space—several thousand feet—has been taken up already. There are daily inquiries and applications from exhibitors old and new, those of 1896 being quite enthusiastic in the way they take up the project and double the amount of space that they used in that year. There are already indications, even thus far ahead, that the managers are likely to be badly cramped for space.

We print herewith two excellent diagrams showing the plan



THE NEW YORK ELECTRICAL EXHIBITION, 1898—PLAN OF AMPHITHEATRE AND CIRCLE.



THE NEW YORK ELECTRICAL EXHIBITION—PLAN OF BASEMENT.

of lay-out for the main floor of the Garden and for the basement. It will be seen that a symmetrical plan has been adopted for the amphitheater, while the heavy operative machinery exhibit will be grouped in the basement. It looks as though a great majority, even of the regular trade exhibits will be in motion, constituting an attractive display at all times. The Show is to run from May 2 to May 31.

MARRIED

CURTIS-CALDWELL.

Mr. Wooster Blake Curtis, of the General Electric Company, and Miss Julia Marshall Caldwell, daughter of Mr. Marshall O. Caldwell, of Schenectady, N. Y., were married December 7, 1897. Mr. Curtis is a native of San Jose, Cal., and an honor graduate of Tufts College. He has been with the General Electric Company for the past five years, during which time he has filled several positions of trust. He holds a high position in the esteem of his comrades from all of whom he carries the very best wishes for his future prosperity and happiness.

SOCIETY & CLUB NOTES

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 119th meeting of the Institute will be held at 12 West Thirty-first street, New York City, on Wednesday, December 15, at 8 o'clock P. M. A paper will be presented by Mr. Thorburn Reid, of New York City, on "Sparking; Its Cause and Effects." After the close of the discussion, Mr. W. J. Clarke, of this city, will give a demonstration in the lecture room of the "Marconi Wireless Telegraphy."

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION.

A well attended annual meeting of this body was held in New York last week, when several matters of importance were taken up and discussed. The report from Secretary Goddard has not reached us as we go to press.

NEW YORK ELECTRICAL TRADES SOCIETY.

A meeting of this credit association was held last week and lasted several hours, being very well attended. The subject of a national organization with local chapters came up and was well received. A meeting is to be held at the Astor House on December 22, at 2 p. m., to adopt certain proposed amendments, one of which lowers the entrance fee. Several new members are awaiting admission to this excellent association.

THE STOCK MARKET

GENERALLY FIRM CONDITIONS.

The outlook of trade and industry throughout the country remains good, and all the indications go to prove a widespread betterment. The postoffice receipts, for example, of several of the leading cities for November, as reported by the Government, show gains ranging from 14 up to 24 per cent., and fifty of the largest offices show gains of 12.4 per cent. average Bank clearings are again heavy, those for seventy-seven cities showing an increase of 25 per cent. over the week a year ago, and within 6 per cent. of the boom year and inflated values of 1892. Railroad earnings are extremely heavy, eighty-one companies for the fourth week of November showing the very unusual increase of 30 per cent. over 1896, while 131 companies report returns for the full month nearly $9,000,000 larger. Exports continue good, and wheat scored a sensational advance of 15 cents a bushel in Chicago, being now likely, it seems, to stay above the dollar mark. If, under such conditions, the country is not prosperous, it never will be.

During the week, 22,788 shares of Western Union were sold up to as high as 90¼. General Electric was quiet, on 2,575 shares at 33⅛. American Bell Telephone was a little lower, 260, on narrow sales. The death of Mr. Hubbard will probably cause a slight decline, but it will rally.

Copper is in better form, and Lake is quoted for the new year at 11 cents, the current price being 10⅞.

REPORTS OF COMPANIES

QUARTERLY REPORT OF WESTERN UNION TELEGRAPH COMPANY.

The Western Union Telegraph Company has issued the following statement:

Surplus July 1, 1897	$7,647,541
Net revenues, quarter ended Sept. 30, 1897	1,703,851
Total	$9,351,392
Dividend 1¼ per cent. Oct. 15	$1,216,972
Interest on bonded debt	224,418
Total deductions	$1,441,390
Surplus Oct. 1, 1897	$7,910,001
Estimated net revenues quarter ending Dec. 31	1,600,000
Total	$9,510,001
Interest on bonds	224,500
Balance	$9,285,501
Dividend of 1¼ per cent	1,216,975
Surplus, after dividend	$8,068,526

In view of the preceding statements, the Executive Committee recommended the adoption by the Board of the following:

"Resolved, That a dividend of 1¼ per cent. on the capital stock of this company be hereby declared payable on and after the 15th day of January next, to stockholders of record at the close of the transfer books on the 20th day of December, instant.

"Resolved, That for the purpose of the dividend hereinbefore declared, the stock books of the company be closed at three o'clock on the afternoon of the 20th day of December, instant, and be reopened on the morning of the 3d day of January next."

TRADE NOTES & NOVELTIES

ACTIVITY OF THE WESTINGHOUSE ELEC. & MFG. CO. AT NIAGARA.

THE report that a branch factory is to be established by them at Niagara is denied by the Westinghouse Electric and Manufacturing Company. They are, however, very busy in that quarter.

The Cataract Construction Company have contracted with the Westinghouse people for an enormous addition to the power station, consisting of five 5,000 h. p. generators of the same pattern as the three installed at present. In addition to these five machines, which are now underway—in fact, shipment has already commenced—the factory is also building exciters, representing a capacity of 675 h. p. The switchboard with necessary appliances controlling the five 5,000 h. p. generators is also being made now, and all of these machines will be applied to the Niagara power house as soon as required.

The Niagara Falls Hydraulic Power and Manufacturing Company, some time ago, contracted with the Westinghouse Electric and Manufacturing Company for six 750 h. p. direct current generators, 300 volts, 250 r. p. m. These generators will be directed connected to Leffel turbines, and they will be used for generating current that will be supplied to the Aluminum factory of the Pittsburg Reduction Company, at Niagara.

The Westinghouse Electric and Manufacturing Company have also constructed two 300 h. p., two-phase induction motors contracted for by the Buffalo, Niagara Falls Electric Light and Power Company. These motors will be used for driving alternating current generators, direct current generators, arc machines, etc.

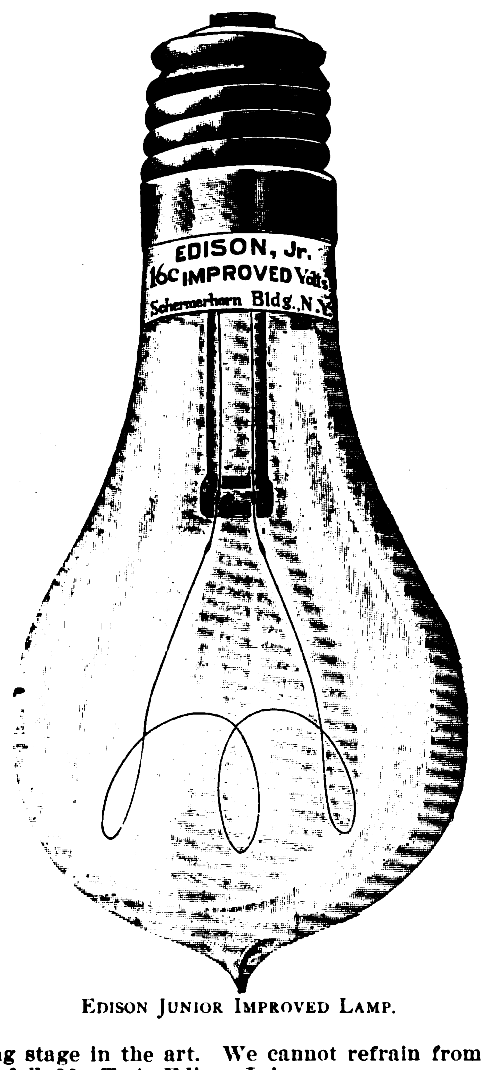
The Niagara Electro-Chemical Company have contracted for a large increase in its transformer station, located above the power house of the Niagara Falls Power Company, consisting of three 235 h. p., two-phase rotary transformers and one 175 k. w. rotary transformer supplying current for the reduction of metallic sodium from caustic soda. In addition to these transformers, the Westinghouse Electric and Manufacturing Company are also making for the same company 800 h. p. in air-cooled oil converters, consisting of six 133 h. p. converters, 3,000 alternations, which will supply current for the rotaries.

The Acetylene Light and Power Company have contracted for two 1,000 h. p. oil converters, water-cooled, of 3,000 alternations, primary 2,200 volts, secondary 100 volts. These converters will supply current for arc furnaces for the manufacture of calcium carbide.

The Mathiesen Alkali Company contracted with the Westinghouse Company some time ago for a number of rotary transformers, induction motors and oil converters, which were recently installed, and consist of eleven 165 h. p. rotary transformers, several small induction motors, twenty-two 82½ h. p. oil converters, four 33½ h. p. oil converters and two 13½ h. p. oil converters.

EDISON JUNIOR IMPROVED INCANDESCENT LAMPS.

WE have made biographical reference elsewhere to the appearance in the electrical field, on his own behalf, of Mr. Thomas A. Edison, Jr. As was stated in our columns last week, he has opened offices in New York City, and is now actively engaged in developing at 96 Broadway his business in the manufacture and sale of the "Edison Junior Improved" incandescent lamps. This new departure constitutes in itself an interesting stage in the art. We cannot refrain from quoting below, in full, Mr. T. A. Edison Jr.'s own announcement to the electric lighting fraternity:



Edison Junior Improved Lamp.

I desire to call your attention to my new incandescent lamp. I know that this is an old, time-worn phrase, but in this case I have something that is a decided improvement on lamps, as they have recently been made. The Edison Junior "Improved" is the result of a long series of exeperiments covering a considerable length of time, carried on in a laboratory that is unexcelled in its equipment for lamp experiments. These experiments were prompted by the inferior quality of lamps, both regarding actual c. p. as well as life, that were being manufactured by the various lamp-making companies.

The poor quality of lamps made has been due mainly to the decrease in the selling price, necessitating the use of cheaper labor and rapid working, but poor apparatus, the result being that consumers are really paying more for their lamps to-day than they did when they paid double the present prices.

The problem, as I have found it, was how to make a really first-class lamp, and at the same time place it on the market without increasing the price now paid.

I feel that I have in a measure solved that problem, not to the extent that I desire or expect to do in the future, but sufficiently so to warrant my placing what I have already accomplished before the trade.

To improve the incandescent lamp as I have found it requires an increase of candle-power and efficiency, as well as a higher degree of vacuum, and it was necessary to make these changes without increasing the cost. This has been done by designing a new vacuum pump that enables me to exhaust ten lamps to a high degree of perfection in less time than is required by the ordinary vacuum pumps generally used to exhaust one lamp.

The saving in time and labor thus made enables me to expend more labor and time upon the filament—the all-important part of an incandescent lamp.

My filament is a chemical combination carbonized at 4,000 degs. F., thereby making it as near absolute pure carbon as it is possible to obtain.

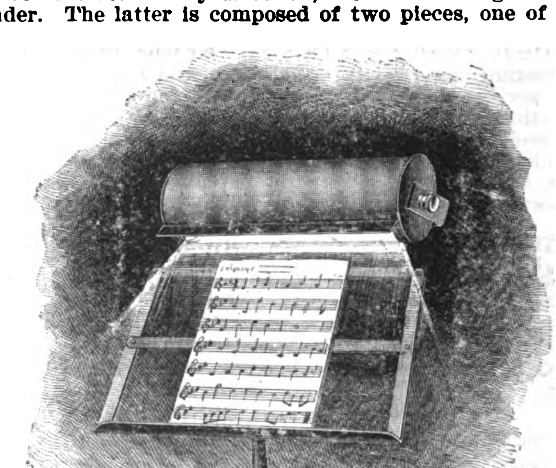
Neither the exhausting apparatus nor the filament has been patented, as the experience of others has proved that patents will not protect me as desired, consequently it has been deemed best to confine these to secret processes.

I believe it can be safely said that the Edison Junior "Improved" Incandescent Lamp will give fully 50 per cent. better satisfaction, under existing conditions of regulation, than any other lamp on the market. My confidence in the lamp leads me to offer them on thirty days' trial, lamps to be returned or payment made before the expiration of that time.

THE WARD ORCHESTRA LAMP.

ALWAYS on the alert to bring about improvements on existing apparatus, Messrs. McLeod, Ward & Co., of 27 Thames street, New York, have just brought out a new fixture called the Ward orchestra lamp, which is illustrated in the accompanying engraving.

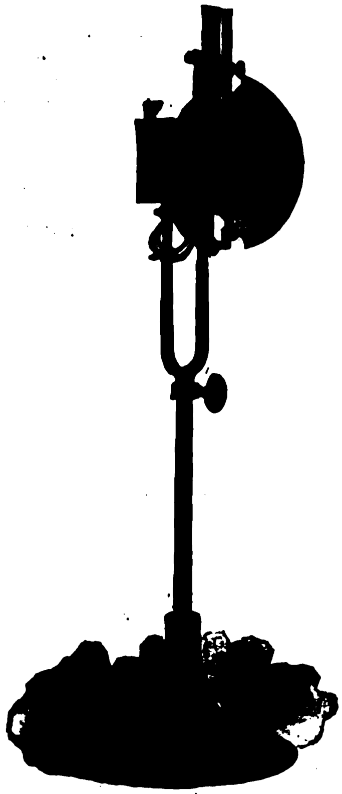
As will be seen, the lamp is cylindrical in shape, the socket being inside the cylinder, which is pivoted on the ends and may be revolved in any direction, the socket being inside the cylinder. The latter is composed of two pieces, one of which revolves inside the other so that any desired opening may be obtained, depending on volume of light required.



Ward Orchestra Lamp.

This device, although called an orchestra lamp, is just as valuable for lighting pulpits and pictures. The rector of St. Thomas' Church, New York, it is stated, experimented with several devices for lighting his pulpit, but did not find anything satisfactory until the Ward orchestra lamp was installed. It is fitted with an adjustable clamp for attaching to music racks. The device bids fair to become very popular.

MANHATTAN FOCUSSING LAMP.



The Manhattan automatic focusing photo-engraving lamp manufactured by the Manhattan General Construction Co., here illustrated, fills a long-felt want for such an article. The continued requests for a lamp of this description, made on the Manhattan Co. within the past three years, during which period the company had placed on the market 15,000 "Manhattan" arc lamps, rendered it apparent that a lamp constructed on substantial lines and to obtain proper results, including among other features, a lamp that will burn at any angle, steady light, no sputtering and the elimination of spots and shadows, so annoying in photo-engraving work, would be very acceptable.

The Manhattan Co. accordingly went into the matter and have perfected their photo-engraving lamp, which they recommend as designed to meet all the requirements for photographic and blueprint work.

The lamp is portable, weighing but 40 pounds, and is constructed to operate singly or two in series on direct current 110 to 220-volt circuits.

SCHIFF, JORDAN & CO.

The works of Julius Fuchs in Nuernberg are now controlled by Schiff, Jordan & Company, of Vienna. Mr. Fuchs has manufactured the "Electra" carbons for a number of years, and will hereafter have charge of the manufacturing department of the Vienna works as well as his Nuernberg plant. Mr. Fuchs has recently made great improvement in carbons for alternating current, and for the inclosed arc lamp. These carbons will be sold exclusively by Schiff, Jordan & Company, No. 232 and 234 Greenwich street, New York.

WALKER APPARATUS ABROAD.

Among the foreign orders that are being filled by Walker Company at present may be mentioned four special belted type generators of 38 k. w. capacity each, which are being built for the town of Lecce, Italy, to be used in connection with a storage battery plant for electric traction.

In addition to these generators, the Japanese Government has ordered, for its own use, a 100 h. p. stationary motor for power, designed to run at 300 revolutions per minute, on a 200-volt circuit.

GENERAL ELECTRIC INCANDESCENT LAMP CATALOGUE.

A new Incandescent Lamp General Catalogue, No. 1,012, has just been issued by the General Electric Company, covering the different kinds of product of the Harrison factory. It is very neatly got up and is published from the company's own printing establishment. It is issued in order that the consumer may have in hand as complete a catalogue of this class of the company's goods as possible. It will be supplied on demand to interested and responsible parties making application for it, or requiring lamps.

HAM SAND BOXES.

One of the latest specialties of the Electric Appliance Company is the Ham sand box for electrical and other street cars. The Ham sand box is different from other boxes made for this purpose in that it does not supply the sand to the track by means of a valve. In the Ham sand box the sand is pushed off of a little shelf by an oscillating finger which is entirely controlled by the motorman. In this way the sand is delivered only as wanted and there is no chance for a valve to become stopped up or blocked open, so that the sand will run continuously, which means a saving in sand as well as better results, as too much sand is just as bad on the track and on the wheels as no sand at all.

Ham sand boxes are popular wherever used, and the Electric Appliance Company are so confident of the success of the device that they are offering to furnish sample pairs on trial wherever a customer will put them on a car and give them a thorough test. For further information address the Electric Appliance Company, Chicago.

ACIDS AND CHEMICALS FOR ELECTRICAL WORK.

Every electrician is aware of the many failures in electrical work, and a number of them can be traced to the impurities found in the commercial acids and chemicals. Some of the largest storage battery companies have discovered this difficulty, and they now purchase all their acids and chemicals under a guarantee of the makers that they shall be free of metallic impurities.

One of the largest systems was first installed at Washington, and they experienced trouble with their battery. Upon investigation it was found the acid contained arsenic and iron, which proved fatal. The telephone companies in many of the large cities have had the same trouble.

It is a well known fact that all acids, especially sulphuric, made from pyrites, contain these impurities to a greater or less extent.

If any of our readers are interested in these matters, we would advise them to consult with the well known firm of Franklin H. Kalbfleisch Company, who make a special grade of chemicals and acids for electrical purposes. They have offices at 54 Maiden Lane, and 29 and 31 Liberty street, New York City, and large works in Waterbury, Conn., and Brooklyn, N. Y. Their goods are meeting with a large demand throughout the electrical trade.

ADVERTISERS' HINTS

THE PRATT & WHITNEY COMPANY, Hartford, Conn., advertise turret head machines in ten styles and forty-four sizes, with latest improvements. Also cutter grinding, screw slotting and shaving machines, milling cutter, reamers, gauges, taps and dies, Renshaw ratchet drills and combination lathe chucks.

THE AMERICAN INDUSTRIAL PUBLISHING COMPANY, Bridgeport, Conn., have just published a practical explanation of the designing, construction, operation, maintenance and the care and management of dynamos, by F. S. Hunting, chief engineer of the Fort Wayne Electrical Corporation. It is sold at twenty-five cents.

THE PRENTISS CLOCK IMPROVEMENT COMPANY, 49 Dey street, New York, will be glad to send their catalogue No. 7,897 in which are described their electric and long running clocks, electrically controlled, which are just the thing for schools, colleges, factories, etc.; time switches for turning off lights and everything electrical in connection with clocks.

THOS. A. EDISON, JR., 96 Broadway, New York, is in the market with the "Edison Jr." incandescent lamp which he claims to be the finest improved incandescent lamp yet introduced.

HAROLD P. BROWN, 120 Liberty street, New York, reproduces a letter from the Weston Electrical Instrument Company which plainly sets forth the efficiency of the Brown plastic bond. Its perusal will doubtless prove of interest to railway managers.

McINTOSH, SEYMOUR & COMPANY, Auburn, N. Y., offer engines of types and sizes for all purposes. Their catalogue may be had on application.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., make some terse observations regarding their methods and apparatus.

McLEOD, WARD & COMPANY, New York, have brought out a useful novelty in the form of an orchestra lamp. It is described more fully and illustrated on another page.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., state that over 50,000 h. p. hours are stored daily in "chloride accumulators."

THE ELECTRICAL EXHIBITION COMPANY, 15 Cortlandt street, New York, make known some interesting facts regarding the exhibition to be held next May in the Madison Square Garden. They will send plans on application.

THE HART & HEGEMANN MANUFACTURING COMPANY, Hartford, Conn., say: "When you want good switches and want them in a hurry, specify 'Hart' and your dealer will ship them without delay."

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, say that sleet and snow will have no terrors for the electric railway manager who has his cars equipped with "Ham" sand boxes. They will be sent on trial to any company who will agree to put the boxes on a car and give them a thorough test.

ANCHOR ELECTRIC COMPANY, 71 Federal street, Boston, Mass., mention a few points in the manufacture of the anchor flush snap switches. One is that the wire for the springs is tested under a strain of sixty tons.

NEW ENGLAND NOTES

MR. GEORGE B. DAMON, of F. P. Sheldon & Company, consulting engineers, Boston, was in the city this week, and speaks enthusiastically of the amount of work, which is being placed in his hands to attend to as consulting engineer, and the large amount of new electrical work which will be taken up in the Spring. F. P. Sheldon & Company are at present consulting engineers for such important companies as the West End Street Railway Company, Boston, the Lowell and Suburban Railway Company, Lowell, Mass., and the Union Street Railway Company, Providence, R. I., and they have achieved for themselves in connection with these plants an enviable reputation, as regards steam and electrical engineering design.

ROLLINS ENGINE CO., Nashua, N. H., report their works busy. Their engines are well adapted for electric railway and lighting plants and other purposes, and are giving satisfaction wherever placed. Among the many places Rollins' engines are installed in can be mentioned the Concord Street Ry. plant, Concord, N. H.; the municipal plant of East Braintree, Mass.; the Waterbury Watch Co., Waterbury, Conn.; White Bros. & Co., Lowell, Mass. They solicit correspondence.

WESTERN NOTES

THE METROPOLITAN WEST SIDE ELEVATED RAILROAD COMPANY, of Chicago, which is equipped with other apparatus, has recently placed a large order for additional motors with the Walker Company, of Cleveland. A similar departure has been made by the New York, New Haven and Hartford R. R., part of whose apparatus of other make will be supplied with current through a Walker switchboard, now building at New Haven, Conn.

KINLOCH TELEPHONE COMPANY, of St. Louis, will hold a meeting of its stockholders January 27, to vote on a proposition to create a bonded mortgage of $1,500,000.

AMERICAN ELECTRIC VEHICLE COMPANY are, it is said, about to build a big plant for the manufacture of electric carriages at Dayton, O. Mr. T. N. Camp has been able lately to show in Chicago the ease with which their vehicles will run over icy, snowy streets, on grades and rough places, where it was impossible for horses to make any way.

TERRE HAUTE, IND.—The Street Car and Electric Light Company has bought two new boilers from the Cahall Company, at a cost of $7,500 for 500 h. p. Another boiler is to be added later.

NEW YORK NOTES

THE FUEL ECONOMIZER COMPANY, Matteawan, N. Y., have placed their Green economizer in the Kent Avenue Power Station of the Brooklyn Heights R. R., also in the Brooklyn Edison Company's new Union Station.

THE YARYAN COMPANY, 142 Times Building, New York, the Eastern representatives of the Hicks gas engine, report an active demand for their double cylinder gas engine, which is particularly adapted for electrical lighting. They have recently installed three large plants in Western New York which are giving very satisfactory results.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, of Chicago, and New York office at 853 Broadway, have begun the manufacture of outlet boxes for the iron armored conduit system and are prepared to make immediate shipments from their New York or Chicago office of any type of box to fit any make of switch or receptacle. They invite correspondence on this subject.

MR. FRANKLAND JANNUS, the well-known patent lawyer, is now establishing himself permanently in New York City, and has opened an office at 1022 Havemeyer Building. He will still carry on his old office at Washington, his headquarters for many years past.

MACHADO & ROLLER, 203 Broadway, N. Y., agents for the Whitney Instrument Company, Penacook, N. H., report good sales and a rapidly increasing demand for this apparatus all over the country. Their A. E. G. incandescent lamps are also in high favor wherever used and are being bought in large quantities by central stations and other users looking for a lamp of maximum life and efficiency. Catalogues, price lists, etc., will be mailed to all interested parties on application.

FORBES & COMPANY, Hoboken, N. J., report their works very busy. Among the notable orders just filled for their electric light engines was one for the U. S. revenue cutter "Bear" of the Pacific Coast station.

PATTERSON, GOTTFRIED & HUNTER, LIMITED, Centre street, New York, have issued a very neat little colored folder, which enables a lady or gentleman to pick out a partner for life. It is called: "Is Marriage a Failure?"

CONTENTS.

Department News items will be found in advertising pages.

The Electrical Engineer.

Vol. XXIV. DECEMBER 23, 1897. No. 503.

MISCELLANEOUS

ON A COAL GAS ELEMENT.[1]—I.

BY DR. W. BORCHERS.

THOSE of you, who have approached the interesting question of "Electricity Direct from Coal"—especially since the suggestive address of our honorable chairman of the 1894 reunión of the Verband Deutscher Elektrotechniker will perhaps recall to mind my communications at the first annual meeting of our society. At that time I suggested that a cuprous chloride solution be used on one side as a solvent for carbonic oxide, and other gases derived from carbon, on the other side as a solvent for oxygen, so as to build up, by using the proper electrodes, an element consisting of carbonic oxide, cuprous chloride and oxygen. As material for the electrodes I employed copper on the carbonic oxide side of the element and carbon on the air side; I selected copper for the reason that I wished, if possible, to construct the entire liquid receptacle of this metal, then to utilize this receptacle as one of the electrodes and thus materially to simplify the arrangement of an eventually useful element.

The apparatus with which I made my first attempts had originally, as you may recall, the form shown in Fig. 1: A glass vessel was divided by two glass plates not reaching quite to the bottom thereof, into three cells having free communication below. The outer cells each held a copper tube for the introduction of the gas, whereas in the middle cell there was suspended a carbon cylinder for the reception of the air. Later, as I already hinted in my first report, (Comp. Report of the first annual meeting of the German Electrochemical Society, published by W. Knapp, Halle a. S., 1894), the apparatus was subjected to the following changes (Fig. 2).

The two copper tubes were cut off, put through sheet copper finely perforated, and furnished with edges so that the sheet copper and the granulated copper laid thereupon were supported by the tubes. The purpose of this change was to increase the surface of contact between gas, electrode and solvent.

In virtue of the attempts made with this apparatus, I suggested receptacles of copper for the liquids (Page 27, Figs. 2 to 5 of the report just mentioned), which vessels should contain the cuprous chloride—carbonic oxide solution, whilst air was to be introduced through suspended porous clay cells filled with cuprous chloride or right from the start with copper chloride solution. I ask your indulgence, gentlemen, for referring to these long known facts. But it seems to me not without importance to point out the differences in the apparatus mentioned in my report at that time.

In the apparatus first described we had, owing to the use of the two impenetrable glass partitions suspended in "rib-glasses" and also made tight with paraffine on the sides toward the carbonic oxide cells, three columns of liquid meeting only at the bottom but otherwise insulated, at whose extremities the active substances were introduced, as I have endeavored to demonstrate in the diagram in Fig. 3. Apart from other defects which might obtain in the apparatus constructed on this principle, the main condition for the construction of galvanic elements was fulfilled by them: namely, the spacial separation of the substances to be electrochemically brought into mutual action. And these were the apparatus with which I arrived at the results which I communicated at that time.

All those who repeated my attempts and reported in detail upon their labors so explicitly that we could recognize the experimental conditions they chose, worked with apparatus in which they attempted to keep apart, by means of porous clay cells, the cuprous chloride—carbonic oxide solution on one side from the chloride of copper derived by help of the atmospheric oxygen on the other side.

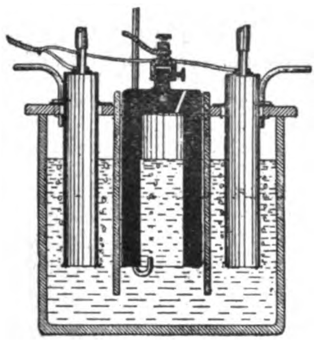


FIG. 1.

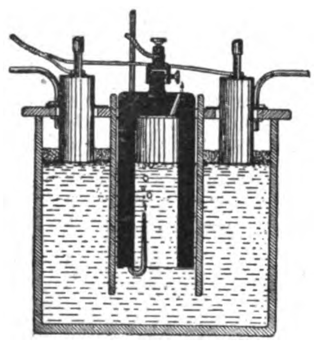


FIG. 2.

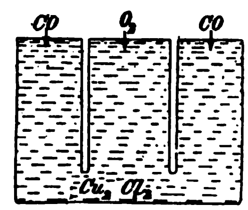
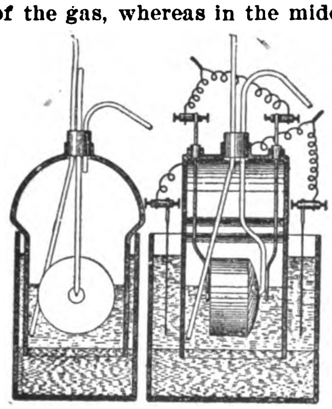
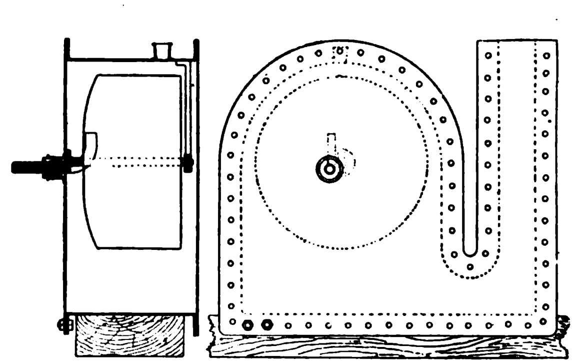


FIG. 3.



FIGS. 4 AND 5.



FIGS. 6 AND 7.

Such apparatus I also suggested; but before I found the time to use them, proof was given by experiments in the laboratory of Professor Häussermann that a sufficient separation of the products of transformation of the electrolytes, which are a condition of the desired reaction, could not be maintained even with the best of the diaphragms known. The apparatus suggested by me as a supposed improvement on my first cells did not, therefore, satisfy the condition of spacial separation of electrochemical reactions; hence they

[1]Read before the Verb. Deutsch Electrotechniker.

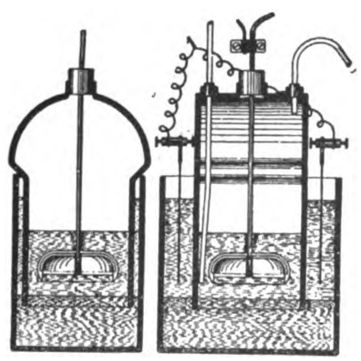
ought to be discarded. When, after being for a long time prevented by more pressing labors, I was able at last to resume the experiments, I came back to my first apparatus again.

In the meantime this objection was urged against me: that the electric current of my element did not arise from an oxidation of the carbonic oxide but from copper in process of solution.

Against this I maintain to this day that the electric current of my element originates from the oxidation of the carbonic oxide and other coal gases contained in generator-gas, illuminating gas, and the like. And I hope, gentlemen, to give you proof at once, for my assertions. Permit me only, gentlemen, briefly to discuss the metamorphoses of my old apparatus, which unquestionably stood in need of improvement in order to be of practical utility.

In order to meet all doubts I secretly took the ground of my opponents of that time, when I resumed my labors. If one of them did really work with an apparatus of the form first described and it could happen at all that copper dissolved continuously or temporarily, the most obvious explanation was, that as against the carbonic oxide absorption and oxidation on one side, the oxygen absorption and cuprous chloride formation on the other could not be regulated in the apparatus with sufficient precision. It was necessary, therefore, first of all, to get under control as far as possible the absorption of carbonic oxide on one side and of oxygen on the other; and, indeed, I believed that I ought first of all to provide for an acceleration of the carbonic oxide absorption. I tried to accomplish this by the construction of movable or fixed electrodes, whose surfaces were brought into contact in continuous alternation with the gases to be dissolved and the solvents.

Examples of such apparatus may be seen in Figs. 4, 5, 6 and 7. The revolving bodies here employed are like those of gas meters; they were set in motion by the gas itself. Figs. 6 and 7 actually represent a gas meter deprived of its registering train and which was provided with a communicating vessel designed to receive the cathode. The electrodes shown in Figs. 8, 9, 10 and 11 were arranged stationary. In the apparatus, Figs. 8, 9 and 10, the three bells made of metal bowls acted as gas raisers in that they were filled alternately with gas and liquid.



FIGS. 8 AND 9.

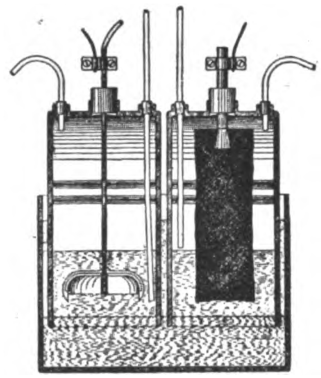


FIG. 10.

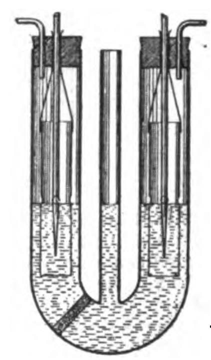


FIG. 11.

I desire specially to draw your attention also to the electrodes in Fig. 11; they are constructed on the principle of the lye-circulation of Borchers Brothers, of Goslar, described in my work on "Electrometallurgy"; simple platinum tubes, open above and below, provided with several openings at about the middle, and suspended by wires so that they dip into the fluid up to about their middle point. If we blow a very fine jet of gas into the fluid through a glass tube drawn to a sharp point so that the column of fluid in the tube is filled with small gas-bubbles, the weight by volume of the column of fluid with the admixed gas-bubbles will be less than that of the rest of the solution. The former, therefore, rises in the tube, overflows through the openings whilst new solution constantly flows in from below.

All these contrivances brought about a lively movement of the electrolyte, favorable to the absorption of the gas, but unfortunately favorable also to the most undesirable mixing of the products of solution formed on the different electrodes. There were now actually two directly opposite conditions to be fulfilled in one apparatus. The acceleration of the gas absorption imperatively demanded a lively movement of the electrolyte; the spacial separation, not less important, of the active ingredients of the solution demanded the utmost quiescence of the liquid bodies.

I hoped to satisfy both conditions, in that I separated both fluids by means of a gelatinized electrolyte, e. g., water glass with hydrochloric acid. You see this indicated in Figs. 4, 5, 6, 8 and 9. The bells under which the electrodes are disposed dip into the gelatinized electrolyte, and in this way the two apparently incompatible conditions were met. But the internal resistance of the apparatus had also become such that I may desist from giving in this place the results of the measurements.

Impelled by the favorable experiences in the electrolysis of alkaline salts solutions with mercury as an intermediate electrode, I now substituted mercury for the gelatine layer, and thereby opened up the following possibilities:

1. If we put solutions of metallic salts into both cells and conduct under a bell jar carbonic oxide, hydrogen and like gases which are known to have the power of precipitating some metals from their solutions we would be enabled to convey the precipitating metal through the mercury into the outer cells and here precipitate it. Even if we had to employ a small electromotive force in some cases we could establish upon this, under certain conditions, a method of precipitating and separating metals from their solutions.

2. If, on the contrary, we kept a weak acid solution in the cathode cell and introduced into it air or chlorine we could expect a transfer of metal from the anode cell through the mercury into the cathode cell accompanied by a production of current.

Experiments in both these directions practically gave such scant results that in this case also I need not go into details. I would only state that I specially undertook the last experiments also with the purpose in view, of working up on hydrochloric acid those quantities of hydrogen and chlorine which originated during the electrolytic production of alkali and chlorine and sooner or later become troublesome, and at the same time recovering a part of the electric energy used in the production of alkali. For this the apparatus in Fig. 10 was especially intended. In the left glass bell jar there was a solution of metallic salt floating on the underlying stratum of mercury. Through the gas "raiser" electrode hydrogen was conducted. Under the right hand glass bell jar there was suspended a carbon electrode immersed in slightly acidulated water. Chlorine was conducted into this. In the anode chamber (left) acid was to form during the process of decomposition of the metallic salt in question while in the cathode chamber (right) the salt in question was constantly to reform when the metal passed hither through the mercury from the anode chamber. Summed up, the results were so far behind my expectation that this apparatus may for the present be left as it is, without my characterizing its principle as incorrect.

When I used carbonic oxide or illuminating gas, in the apparatus illustrated in Figs. 4, 5, 8 and 9, using cuprous chloride here as electrolytic while in the outside cells lead or manganese peroxide electrodes were kept in dilute sulphuric acid, greater electromotive forces, about 0.5 volt, were indicated.

COUNTER E. M. F. OF THE ARC.

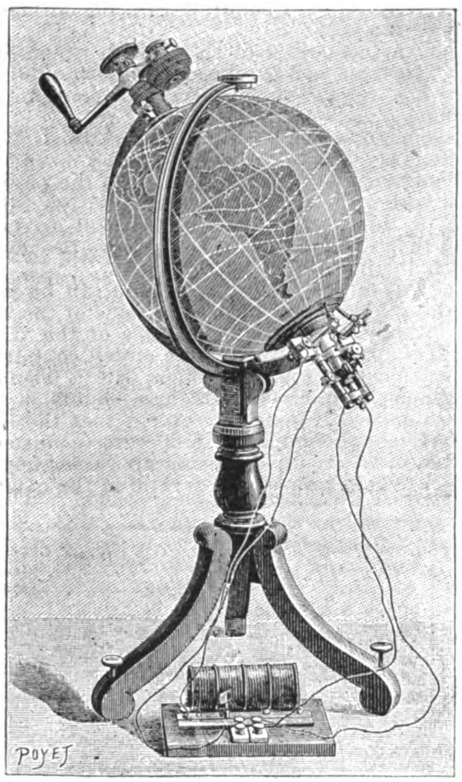
R. Herzfeld publishes the results of some experiments on the arc light which are of both practical and theoretical importance. To test the hypothesis that the "counter e. m. f." of the arc is due to the deposition of electrified particles upon the cathode, he deflected these particles in their course by a strong electric field, and made them deposit themselves on one of the condenser plates. This deflection produced no effect upon the voltage. The particles only deposited themselves upon the insulated plate, even when that was 15 times further off than the other plate. The author also investigated the nature of the much-discussed fungoid deposit upon the electrodes which Mrs. Ayrton described as characteristic of a hissing arc. Herzfeld found that this growth was much increased by en-

closing the arc in a glass tube, and he attributes it to the lack of oxygen necessary for the complete combustion of the carbon. He also noticed a curious phenomenon. The growth is deposited in a spiral form whenever magnets are about. The path of the projected particles is twisted in a direction contrary to that of the currents in Ampere's molecular magnets. The author also endeavored to determine the precise influence of temperature upon the voltage of the arc; and for this purpose blew a current of cold carbonic acid from the solid substance against the electrodes. The voltage was increased equally whether the anode or the cathode was impinged upon. This shows that the counter e. m. f. is probably not a thermoelectric effect.

THE WILDE MAGNETARIUM.

M. WILDE recently presented to the French Academy of Sciences an apparatus which he calls a magnetarium, and which is designed to reproduce the phenomena of terrestrial magnetism and the secular changes of the horizontal and vertical components.

The apparatus consists of two terrestrial globes, one of which revolves within the other. An insulated copper wire is wound around the inner globe, the axis of which makes an angle of 23.5 degrees with that of the outer one, so that its equator revolves in the plane of the ecliptic. The interior surface of the globe is likewise provided with a winding of insulated wire, and the surface of the seas is covered with thin sheet iron, in order to cause a difference between the magnetism of the terrestrial and maritime regions.



THE WILDE MAGNETARIUM.

The axes are provided with insulated rings, which revolve along with them. Copper brushes in contact with these rings cause electric currents to pass around the surface of the globes. By means of a train of epicycloidal toothed wheels, a slow differential motion is communicated to the internal globe, thanks to which there may be accurately reproduced the principal phenomena of terrestrial magnetism and the secular variations of the declination and inclination that have taken place for the last three centuries at London, the Cape of Good Hope, Saint Helena and Ascension Island.

The period of time that corresponds to a difference of one revolution in the rotations of the two spheres is 960 years, and the annual retardation of the electro-dynamic sphere is 22.5 minutes. This period comprises all the different secular variations of the magnetic elements upon the different parts of the terrestrial surface.

The apparatus likewise reproduces the various elements that follow: (1) The inequality of the periods of declination upon the same meridians in the northern and southern hemispheres as observed during the short period of western elongation at London (160 years) and during the long period of western elongation at the Cape of Good Hope (272 years) and at Saint Helena (256 years); (2) the simple displacement, in one direction or the other, of the dipping needle for the double movement, forward and backward, and of the declination needle, as it has been observed since the year 1723 in the continuous diminution of the dip for the British Islands during the motion of the declination needle toward the west and its return; (3) the changes of dip in an opposite direction upon the same meridian in the northern and southern hemispheres, as observed during the present period in the dip that diminishes in the British Islands and increases at the Cape of Good Hope, Saint Helena and on Ascension Island; and (4) the rapid increase in the dip in the vicinity of the Atlantic node of the magnetic equator (17 minutes per annum), as observed in the first place by Sabine in the Gulf of Guinea and at Saint Helena, as well as the western progression of this node itself.—La Nature.

STERILISATION OF IMPURE WATER BY OZONE.

BY E. ANDREOLI.

THE progress realized in the construction and in the method of working ozone generators has been such lately that ozone can now be produced in large quantities and in a continuous manner, and industrial applications of ozone which, a short time ago, were still deemed hopelessly impracticable, can at present be effected at a relatively low cost, and even on a scale of real magnitude. As long as the yield of ozone obtainable per horse power hour did not exceed 20, 25 and 30 grammes, and the apparatuses were not absolutely capable of working in a continuous manner without breaking down, or getting out of order, it would have been unreasonable to speak of utilizing ozone for the purification of drinking water. To-day, however, we must alter our mind on this subject, and admit that ozone can, even on a very large scale, purify, deodorize and sterilize impure water, and render it wholesome and drinkable.

Ozone is a powerful oxidizing agent, which does not contain any chemicals, does not impart any smell or taste to water, and acts with great energy on organic matters and micro-organisms, which it destroys. After it has oxidized the organic matters, and killed the microbes, germs, etc., contained in water, ozone returns to its primitive state of oxygen. Thus, after ozonization, the impurities of polluted water disappear, and the purified water contains a slightly larger proportion of oxygen. Drinking water must, above all, be free from infectious matter, i. e., living organisms, and although the microbes it contains may not be pathogenic, if their number is great, we can safely conclude that the water has been contaminated by substances in a state of decomposition.

Sand filtration on a large scale does not totally purify the water supplied to towns and villages. Small filters are very inefficient for individual purposes. Oxygen does not act upon organic matters or bacteria present in water; ozone, "the great oxidizer of nature," as Prof. Dewar says, has, on the contrary, a destructive action on bacteria.

The two sine qua non conditions for the sterilization of water on a large scale are: 1. The yield of ozone per horse power must be high. 2. The ozonization of water must be perfect, i. e., all the molecules of the mass of water must be brought into intimate contact with the ozone, in order that all the objectionable matter in suspension in it will be brought under the action of oxidizing gas.

With regard to the first desideratum, viz., to the quantity of electrostatic ozone which can be obtained per horse power hour, we may safely say that we guarantee a minimum of 100 grammes. This apparently small quantity of ozone, if properly applied, i. e., without loss, and according to an efficient method, will disinfect, say, 2,000 gallons of water of an average impurity, one which is not too much polluted.

Taking the cost of 1 horse power at 2 cents:

10 h. p. hours yield 2.2 pounds of ozone.

1,000 h. p. hours yield 220 pounds of ozone.

If we assume for argument's sake, working with a 1,000 h. p. installation, therefore 2,000,000 gallons may be disinfected every hour; this represents a total of 48,000,000 gallons per 24 hours; and even if half of this quantity of water could be disinfected, or even less, it still represents an appreciable amount of sanitation effected at a low cost.

We may confidently appeal to the scientific and medical world, and ask the bacteriologists, and the most competent men on questions of hygiene and salubrity of water, to decide on the soundness of this pursuit for utilizing ozone for freeing drinking water from living organisms and infectious matters.

We made some experiments last year, when our apparatus were yielding about 30 grammes of ozone per horse power hour. Now that we have at our disposal an output of over

100 grammes per horse power hour, we are getting ready to repeat these experiments on impure water, on water contaminated with sewage and with different kinds of microbes, so as to demonstrate the germicidal and sterilizing properties of ozone, not only in laboratory experiments, but on a large scale. —London Elec. Rev.

TELEPHONY AND TELEGRAPHY

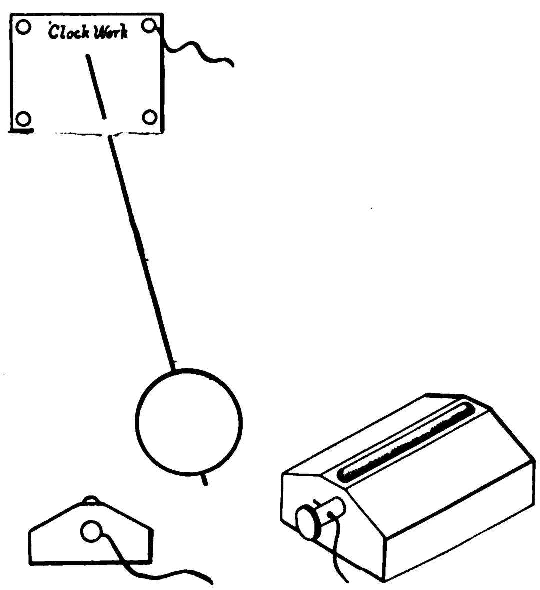
USE OF THE TELEPHONE AS A GALVANOSCOPE.

BY GEORGE T. HANCHETT.

THE amount of current which will actuate a telephone receiver so as to make an audible sound is extremely small, a mere fraction of a milliampere, and for this reason it is one of the most delicate galvanoscopes that we have, and is moreover possessed of properties which will enable its use in places where a galvanometer or galvanoscope is entirely inadmissible. In making this statement, the writer is fully aware that he is not enunciating any new principle, but it is believed that this article will find audience for the reason that the fullest advantage has not been taken of this most important property of the telephone.

Certain modifications in the use of this instrument in testing will be shown and a number of places where it can be used to much greater advantage than a galvanometer will be pointed out.

The use of a telephone receiver in testing is essentially con-



FIGS. 1 AND 2.

fined to what are known as null methods—that is, tests which employ the arrangement and adjustment of the current in a certain circuit to zero in order that certain other things whereby quantitative measurements can be made will be true. The most familiar example of a null or zero method obtains in the case of a Wheatstone bridge, in which instrument the various resistances must be adjusted in exact proportion before the current in the test circuit will be reduced to zero. In such a test circuit a telephone could be placed, together with a suitable device for interrupting the current. As long as there is current in the test circuit a series of clicks will be heard in the telephone, but when there is no current silence would obtain.

The telephone is not absolutely free from exterior magnetic influences, but by proper arrangement it will be easy to distinguish between these exterior disturbing influences and those for which adjustments are being made, no matter how powerful the former may be. In the first place, the interrupter should be provided to make contact at a certain definite period whose frequency cannot be mistaken; then spurious currents flowing in the testing circuit such as static discharges or inductive influences will be recognized as such, because the noise they cause in the telephone receiver will be entirely different from the regular clicking caused by the make and break.

This interrupting device had better be driven by clockwork. An excellent arrangement is to secure the works of a pendulum clock and arrange a mercury contact, such as is shown in Fig. 1. A piece of hardrubber should have an elongated depression made in it, as shown in Fig. 2, so that it will contain a little thread of mercury. This is supported under the pendulum with the thread of the mercury at right angles to the swing. If the little trough is filled quite full there will be a considerable meniscus, and due to its elongated shape the pendu-

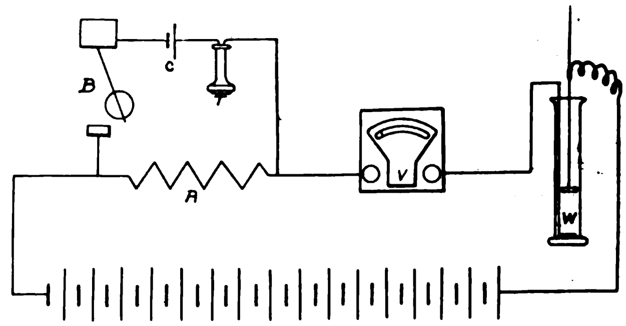


FIG. 3.

lum will never miss it, as it might, in case the ordinary globule contact was used.

This instrument connected in series with a source of electricity and a telephone will produce an unmistakable click and, after the ear has become sufficiently accustomed to it, it will not be confounded with anything else.

This arrangement, which provides that distinct clicks occur at definite intervals, makes the entire system much more delicate, for having once become accustomed to the periodicity of the click and gotten the mind in step with it, the adjustments can be made to minimize it and the ear will detect a much feebler sound than it otherwise would because the mind knows when to listen for it.

Perhaps the advantages of the telephone can be more fully set forth by describing its application to some of the most common cases. Taking the familiar example of the Wheatstone bridge we will suppose that the testing circuit contains a clock interrupter, as shown in Fig. 1, together with a telephone, and that the telephone is shunted with three shunts in the same way as an ordinary galvanometer, except that the last shunt is a particularly short circuit. The operator connects his unknown resistance in circuit, estimates approximately what it may be, and chooses a proportionate ratio in the balance arms

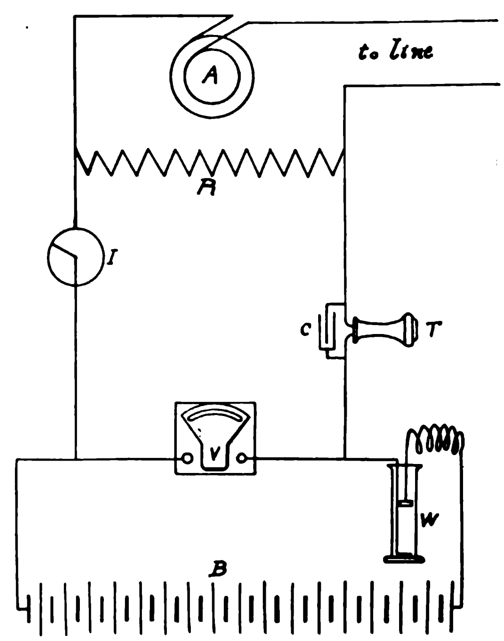


FIG. 4.

of the bridge. He selects a value in the rheostat and opens the shunt switch on to the first notch. A loud, discordant click betrays the condition of unbalance and he adjusts the resistances until this becomes fainter and fainter, and gradually increases the resistance of the telephone shunt until it is altogether removed.

The proper telephone for this purpose is a watch-case receiver, which can be secured to the head with a spring clip. There is no waiting for the galvonometer to come to rest, no undue deflection from outside influences, and, therefore, the measurement can be made with greater rapidity. Further than that the attention of the eyes need not be removed from the bridge, thus rendering a mistake much more difficult.

The users of mirror galvanometers can testify to the fact that the continuous observation of a dancing spot of light is distressing to the eyes and they will certainly appreciate a device by which the ear may be substituted. The great objection to the needle system of telegraphy has been that the eye wearied of observing the motion of the needle, whereas the sounder in which the ear was the recording sense has not this objection, the ear being an organ of much more endurance than the eye. Where many measurements of resistance are to be made this will be appreciated. It will be presently shown that in the case of rapid measurement, where the greatest accuracy is not desired, the telephone is an infinitely preferable detector.

In the calibration of a voltmeter the advantage of a telephone over a galvanometer is even more strikingly apparent. The connections are shown in Fig. 3. The Poggendorff potentiometer method is used, but instead of the galvanometer the telephone and interrupter are substituted. The resistance, R, is calculated approximately by the reversal of the formula, and the water resistance, W, is then manipulated for silence in the telephone. The only thing that the eyes need to observe is the voltmeter and as the water resistance variation throws the needle up or down two places are quickly found where the noise begins, and between those two places on the voltmeter scale the telephone is practically silent. These two places are liable to be less than one division of the scale apart and recording the voltmeter deflection by estimating tenths the writer has seen two different persons make readings that check to the tenth on the scale division. There is no danger of straining the standard cell, C, because the interrupter is in circuit with it and closes the circuit only a fractional part of a second at considerable intervals. With a galvanometer there is not only the difficulty of waiting for it to come to rest, and the influence of spurious external influences, but also the very important difficulty that when the resistances have been adjusted for zero deflection, and that fact has been established to the satisfaction of the observer, if he turns to look at the voltmeter, the conditions may at that instant change the deflection of the voltmeter, and thus many sensible errors will be incorporated into the calibration curve.

In taking the curves of alternators or pulsatory currents the telephone is the only instrument that will give absolutely satisfactory results without the expenditure of too much labor. The connections of a simple method are shown in Fig. 4 in which the current curve of an alternator is to be taken.

In this case the clockwork interrupter is omitted because the contact made on the instantaneous contact commutator, I, provides the pulsatory current, which is to be reduced to zero by the balancing e. m. f. which is measured by the voltmeter, V. In this case, as in that of the calibration of the voltmeter, the same convenient adjustment of the voltmeter for silence in the telephone occurs. The ear detects the instant when the current in the instantaneous circuit is zero and the eye simultaneously reads the voltmeter deflection. To be appreciated fully, this method must be tried.

A condenser, C, placed in multiple with the telephone receiver tends to make the noise of a pulsatory current louder and more prolonged. The reason is obvious. The condenser is charged at the same time that the impulse of current passes into the telephone and when the circuit is broken the condenser discharges into the receiver, prolonging the pulse of current and accentuating the noise that it makes. Therefore, the use of a condenser renders the effects of a more minute current audible than could be detected without its use.

In rough testing work about a railway repair shop or factory for electrical apparatus the telephone is invaluable. For instance, where an armature is to be tested for short circuited bobbins the test brushes could be placed on the bars on the terminals of a good bobbin and the bridge adjustments made for silence in the receiver. Then as the brushes passed from coil to coil there might be a slight sound due to inequality of the length of the bobbins, but when a short circuited bobbin came under the test brushes, a loud series of clicks in the telephone would announce its presence.

Where the telephone is used on circuits of very high voltage, such as might occur in taking the e. m. f. curves of a high potential alternator, it may be necessary to place in series with the testing circuit, a considerable resistance to protect it. If an ordinary coil resistance is used, its self-induction will prevent a sudden pulse of current from attaining the magnitude that it would have if it had to encounter a simple resistance only, and consequently the clicks in the receiver will not be so pronounced, and the apparatus will be less delicate. It is not a convenient matter to make a large non-inductive resistance of wire and the writer suggests the following expedient, which will be found very satisfactory:

Procure some small glass tube about one-fourth of an inch in outside diameter. Bend a length of it into a U-shape, clamp it into an upright position and insert wires in either end. If the tube is now filled with water that is pure, a comparatively short length will be found to provide a considerable resistance. This resistance can be varied by pushing the connecting wires further into the tube. If a greater resistance is desired a system of these tubes may be connected in series. If it is attempted to pass too much current through one of these resistances the steam generated will break circuit by interposing a bubble which will presently rise to the top of one of the legs of the U and disappear, thus restoring the broken circuit. If a heavy voltage is suddenly applied by accident the resistance is liable to explode, especially if water to which salt has been added is used. However, this resistance in the case in hand is to be inserted to protect a circuit in which it is endeavored to make the current zero and hence its carrying capacity will not be an objection.

The danger of disrupting the resistance by too much current may be practically obviated by connecting the tube to a source of supply and circulating water through it. If in such a case enough vapor should be generated to break circuit by means of a bubble, continuity will at once be re-established by the running stream. If this device is used a rubber tube will be found best. An excellent arrangement will be to provide two pails and arrange the tube to siphon the contents of one pail into the other. When the flow is about to stop for lack of water in the upper pail, reverse their positions. The wires may be connected to plates immersed in each pail or to the pails themselves, if the latter are of metal. If desirable, water, the resistance of which has been lowered by the addition of salt, could be used. If the testing circuit is one of high voltage it will be well to insulate the pails from the ground and from each other by means of square boards resting on four glass tumblers or telegraph insulators.

In using a telephone receiver for testing on power circuits it should be protected by one or two shunts, which may be thrown out at will. This has two objects. In the first place, it protects the telephone receiver from heavy currents, and, in the second place, it protects the ear of the operator, for if the circuits are largely unbalanced, the click in the receiver is painfully penetrating and even injurious; in fact, it might be well in some cases to make the preliminary adjustments with the receiver at some distance from the ear, and only listen closely after condition of balance has been nearly obtained.

THE HUMMEL SYSTEM OF TEL-AUTOGRAPHY.

A SPECIAL dispatch from St. Paul of Dec. 8, says: Ernest A. Hummel, a manufacturing jeweler of this city, has invented a device which will send photographs over thousands of miles of telegraph wire. Mr. Hummel has made three tests in the last few days, which prove that a photograph can be sent over the wires as far as words and with remarkable accuracy.

Mr. Hummel telegraphed over 320 miles of wire on Sunday striking likenesses of Adolph Luetgert, now on trial for murder in Chicago, Albert Scheffer, a well known St. Paul politician, and Mrs. H. R. Gibbs, a Minnesota temperance leader. The instrument will be useful in sending by wire photographs of prominent persons during conventions and probably of great service in the detection of fleeing criminals.

Mr. Hummel's device is somewhat intricate, combining three or four different motive powers. Transmitter and receiver are each largely of brass and, while heavier in construction, would but for the projecting table on which the drawing of the picture in the one or the blank paper for the impression in the other is placed, not occupy more space than an ordinary typewriting machine.

Receiver and transmitter each has a diminutive electric motor, smaller than the case of a small pair of glasses, which operates the carriage which hauls the copying pencils of the machine back and forth over the area to be copied. In the transmitter this carriage is equipped with a projecting arm, in whose vulcanized rubber extremity is inserted a sharp platinum point.

This platinum point is drawn by an ingenious automatic clockwork contrivance over the surface of the plate each time a minute distance from the line in which it moved before, the adjustment being accomplished by a screw and a triple series of ratchets which, by turning the screw more or less, regulate the width between the lines.

After the machine is connected with the electric circuit and the platinum point is set in motion each time it encounters a

strip of shellac the circuit is broken. This break in the circuit throws down against the receiving paper in the complementary part of the machine a sharp needle point, which etches into the surface a line corresponding to the course taken by the platinum point while on the shellac insulation. When the platinum point has passed over the shellac and the circuit is again closed the needle point is lifted.

The most careful adjustment of the clockwork is necessary for harmonious working of the instruments. While the carriage is propelled by the electric motor the clockwork is necessary to control its velocity, and this is accomplished with the assistance, in addition to the ordinary looking system of cogs, of several whirling fans, not unlike the governor of a steam engine, except that they have disks instead of spheres. The instrument takes a complete photograph in about twenty minutes.

A CARBON DETECTOR OR RECEIVER FOR HERTZ WAVES.

DETECTORS of the Hertz electromagnetic oscillation (such as those of M. E. Branly, Comptes Rendus, 785, 1890) consist of small tubes partly filled with metallic filings, furnished with pole-pieces in contact with the filings. M. E. Branly, in his excellent paper, makes no mention of having tried carbon as a Hertz wave receiver. I find that receivers having carbon contacts have been spoken of as useless. Prof. Oliver Lodge in his book—"The Work of Hertz"—mentions in a footnote (p. 30) that Prof. Fitzgerald has succeeded with carbon. but no references are given to experiments on the point.

Thinking it possible that the smallness of the particles of carbon might affect the result, and that powdered carbon might not act in the same way as an ordinary carbon microphone which had been tried, I reduced some electric lamp carbon to the finest powder, and placed it in a thin glass tube furnished with terminals; the detector I thus made was placed in a circuit, including a dead-beat galvanometer (resistance 50 ohms), one dry cell e. m. f., 1.4-volt, and about 8,000 ohms added resistance.

When the circuit was closed, the carbon receiver having been previously tapped or gently shaken with a vibrating fork, the galvanometer indicated that a small current was flowing in the circuit. The carbon detector was exceedingly sensitive to the slightest electrical disturbance. To get the best result the resistance of the carbon receiver should be such that a small current can flow through it. This condition is easily obtained by furnishing the carbon receiver with pointed terminals, which can be screwed to any required depth into the powdered carbon. On trying to set up the same conditions with a detector containing metallic filings (nickel, iron, copper, silver), difficulty was experienced in so adjusting the terminals that a small current should flow, but with carbon the difficulty entirely vanishes.

The carbon receiver proved itself to be a most interesting instrument. During a thunderstorm which took place within a few miles of Oxford on the 27th of July, the galvanometer indicated that each flash slightly reduced the resistance of the carbon receiver, and the spot of light was shifted by successive jerks in the same direction till quite off the scale; the night being still, the gradually approaching storm could be well observed.

After the movement of the spot of light the time was taken with a stop chronograph watch, and after 50 seconds the thunder could just be heard, the lapse of time indicating a distance of over 10 miles. During 40 minutes, the time between the indication of the carbon detector and hearing the thunder changed to 10 seconds, which was the minimum time.

Some detectors similar in dimensions, but made so that they could be exhausted, were tried at the same time, the different detectors being thrown into the circuit by means of a switchboard; the vacuum does not appear to improve the action. The tubes were carefully made by the late Mr. E. Cetti, and exhausted in November, 1896. From these, and many other experiments, I believe that carbon, instead of being a useless substance as a detector of Hertz waves, will be found (when in fine powder) to be both reliable and certain in its action.

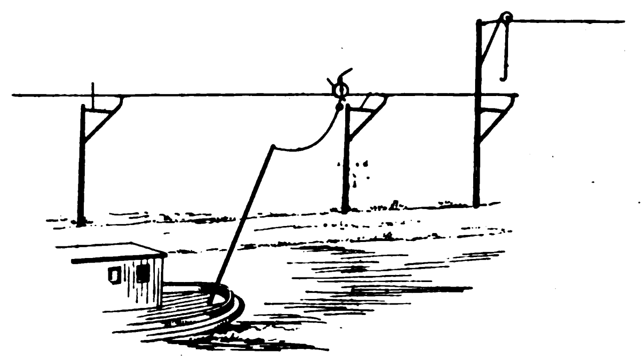
During the storm I have spoken of the apparatus was placed on a table in a room, the door and windows of which were closed. The instrument was not in connection either with the earth (except in as far as it rested on a deal table) or with any conductor extending into the air outside the house.

I have fixed a mast to the roof of the house, so that a conductor may be easily hauled up it; when the detector is connected to this and also to the earth, atmospheric electricity interferes considerably with telegraphy with a Branly or my powder carbon detector.—London Electrician.

ELECTRIC TRANSPORTATION

TROLLEY CONNECTION AND LOCOMOTIVE FOR TOWING CANAL BOATS.

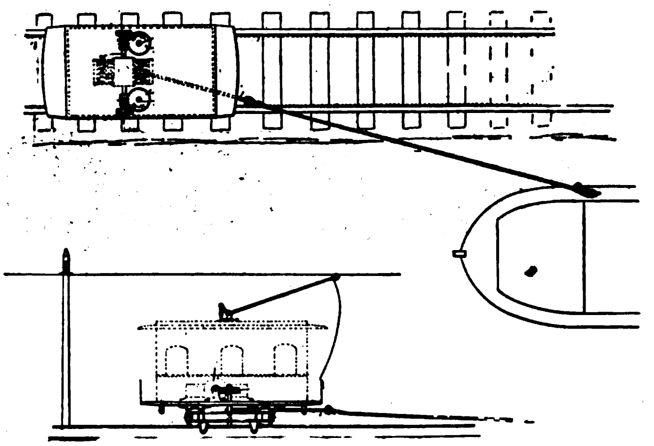
CANAL boat propulsion, after being dependent from time immemorial on the horse, steam and other motive powers, is daily developing a wider application of electrical devices. Among recent patents is a trolley connection for canal boats, the invention of Frederick J. Shewring, Toronto, Can. This invention provides a trolley connection which will make a practically perfect circuit between the line wire and feeder for the motor, and at the same time offer no obstruction to the successful navigation of the vessel. The mechanism, which is cheaply made and easily operated, includes a rigid trolley pole permanently attached to the boat, mounting on the trolley wire a gravity-balanced trolley wheel, and connecting the trolley pole and wheel with a wire of sufficient play to permit of freedom in the movements of the vessel. At the junction of two canals the trolley wire must be sufficiently high to avoid any possibility of its coming into contact with the vessel or parts of the vessel passing below it, or of its obstructing the mast or other elevated parts. To accomplish this, it is necessary to extend the poles at the junction of the canals to an elevation above the masts of the vessel, and to provide these poles with arms, braces, and an elevated trolley wire in circuit with the main trolley wire at a lower elevation. Mounted on the elevated trolley wire is a trolley wheel having a depending rod or wire, the lower end of which is hook-shaped to engage the eye of the trolley wheel. By this construction the trolley wheel can be carried across the junction of the canals and the circuit maintained in the motor. The use of this trolley connection can be applied to other purposes than canal boat service, as it may be employed in connection with any other trolley system where the rigid trolley pole can not be satisfactorily used. By means of this invention a circuit can be established between the line wire and the vessel in such a manner as to avoid all difficulties and inconveniences which might arise from the motion of the boat or the changing of direction or irregularities of the canal bank. Another advantage is that the use of cross wires over the canal can be entirely dispensed with and a free channel secured for navigating the vessel. The action of the device is as follows: The trolley wheel is mounted on the line wire making contact. The balance maintains the wheel in an upright position during traverse from end to end of the wire, the current passing through the trolley wheel through the vertical frame, and the slack wire to the trolley pole, from whence it is conveyed to the motor. This slack wire connection prevents the rolling or rocking motion of the boat from affecting the trolley wheel, and the liability of the wheel leaving the wire is minimized. The trolley pole is preferably connected to the stern of the boat, which in traveling draws the trolley wheel after it along the line wire.



SHEWRING'S CANAL BOAT TROLLEY SYSTEM.

Another addition to the list of recent electrical devices for canal boat propulsion is an invention of Edwin A. Leland, Great Barrington, Mass., which employs a locomotive moving along a railway on the canal tow-path. At the inner side of one of the track rails, or preferably of each rail, is a rack with teeth projecting laterally, so as to cause the dirt to drop off and pass to a point beyond the rack. The truck of the motor is provided with flanged wheels, and depending from it on

each side are brackets carrying rollers to run on the under side of the rail-flange to hold the car onto the track. Mounted on the car in bearings is a horizontal transversely-arranged shaft, which is rotated by an electric motor supplied with current from an overhead line. This shaft carries a worm, preferably one at each end, gearing with a worm wheel on the upper end of a vertical shaft, the lower end of which carries a pinion in gear with a rack. When the shaft rotates the action of the pinion on the rack causes the car to be propelled steadily, with no liability to slip back on an up-grade, as in mounting a lock. Suitable bearings are provided beneath the car for the pinion shaft or shafts. In certain cases a single rack and pinion will suffice, which may be arranged adjacent to either track rail, or located midway between the two



LELAND'S CANAL BOAT HAULAGE SYSTEM.

track rails, the worm gearing on the car being arranged centrally to correspond. Attached to the motor car by means of a coupling pin is a draft rod or draw bar, made reversible so that the tow line, which it is to carry, can be connected with either end of the car. The inner end of the bar is preferably supported in a bracket beneath the car and has an eye for engaging the coupling pin, by withdrawing which the bar can be detached and again connected to project in an opposite direction. Under the opposite ends of the car are guide brackets to support the outer portion of the drawing bar. The car platform may be equipped with a cab for the protection of the motorman from the weather. The car can, it is said, take any grade without slipping, by means of its rack and pinion gearing, or propelled with equal facility in either direction.

THE PER CENT. SYSTEM OF RANKING EMPLOYEES AS USED ON THE METROPOLITAN ELEVATED, CHICAGO.

NOW that the mechanical and electrical difficulties that formerly beset electric railway operators are pretty thoroughly straightened out, more attention is being paid to the proper treatment and discipline of employés. And surely there is no more promising field for improvement in electric railway practice than this, for it is the employés that have the safety of passengers and equipment in charge, and on them the safety and comfort of passengers and the treatment of apparatus depends.

Anything that rasies the standard of service is money in a company's pocket. As illustrating how well this fact is coming to be appreciated, we know of one successful engineering firm making a business of taking charge of railway plants in financial distress and, the writer understands, it is their policy on taking charge to look not so much to the electrical and mechanical department for chances to work economies, as to the employment in service of employés. This is done by making it a considerable object for each man to give the best service possible.

The per cent. system of marking and promoting employés as used on the Metropolitan West Side Elevated Railroad at Chicago, which it is the purpose of this article to describe, has been in use on that road for some time, is certainly planned along excellent lines, and is in the direction of progress. We are indebted for the details to Mr. W. E. Baker, general superintendent, and A. S. Jones, superintendent of transportation, by whom the system has been worked in its present form, and to whom is due the credit for pioneer work along a line which others will surely follow.

The general aim of the system is to make the promotion of all employés dependent on merit and at the same time, other things being equal, to promote the employé oldest in the service. Thus an important inducement is held out to each one to maintain as good a credit as possible. This is accomplished by keeping a debit and credit account with each employé, the debits and credits being based on his or her actions. The relative rank of trainmen on the road is as follows: (1) Motorman, (2) Conductor, (3) Guard, (4) Extra Guard. The motormen being in the most responsible positions receive the highest wages, the conductors next, and so on down.

The peculiar thing about this arrangement, however, is that any extra men are supplied from the rank below. Thus, when extra motormen are required they are taken from the top men on the conductors' list. Extra conductors are taken from the highest on the guard list, so that the only real extras are the extra guards. Of course this is an arrangement suited only to elevated roads, and on a street railway it would ordinarily be necessary to keep the conductors and motormen separate because of the widely different requirements for the two positions. On an elevated road the conductor's duties are such as to prepare him for being a motorman as he becomes familiar with stations, signals, etc., and on the Metropolitan he is instructed in a motorman's duties so as to be ready to serve as such.

When a man enters the train service he is put on the extra guard list and an account is opened with him on the company's credit books. He is at once credited with 100 per cent. As long as his behavior is good he is credited each month with 2 per cent. In this way his credit account is always on the increase as long as nothing is reported against him. If he breaks the rules or is guilty of other carelessness he is fined or docked a certain per cent., sometimes equal to and sometimes in excess of his monthly credit. When it is necessary to fill vacancies on the guard list, the extra guards with the highest percentages are taken, and so on up through each rank. The motormen having the highest percentages get the most desirable runs. Thus it is seen that when this system is properly administered it becomes a merit promotion system, pure and simple, in which the oldest in service gets the promotion, in case the merit is equal.

As soon as a man is promoted to the next rank above, a new account is opened with him and he is credited with 100 per cent., just as before. He then goes on working his way up through the list—or down, as the case may be.

All credits to or deductions from a man's per cent., are announced by posted bulletin and the lists are at all times open to inspection. There is nothing secret about the system. This openness in all dealings is important, as it prevents distrust and fear that all are not getting fair play or that the marking is done in an underhanded way.

The only punishments are in the shape of fines or deductions. Suspensions are unknown. When a man's standing and chances of promotion depend so directly on his behavior, these fines have just as good a moral effect as suspensions—in fact, better, for suspensions create dissatisfaction where fines will not.

Credits are given for specially good conduct, just as fines are imposed for bad. For example, if a guard prevents a platform accident by prompt action where the opportunity for the accident was due to no fault of his, he would be credited with a few per cent. in addition to his regular monthly increase. This would be announced by a bulletin and the reasons and circumstances explained. On the other hand, should a motorman disregard a signal, for instance, he would be fined a certain per cent., and the fact and circumstances announced by a bulletin. This may appear like rough treatment, and it might be argued that the publicity of a man's disgrace is unnecessary and harsh. However, as publicity is essential to the success of a system of this kind, and as this plan of bulletins comes to be accepted as the regular thing, there is no harm in it. It is rather an educator. A man sees that some one has been fined for a certain offense and it serves as a reminder and a warning to him to avoid a similar offense. If he sees a credit is given for exceptionally good conduct it is an incentive to him. With a system of this kind properly managed, the hope of reward by promotion is a more powerful factor than fear of punishment and everyone knows that this means an improvement in the standard of conduct.

Of course much depends on the good judgment and fairness of the officials who impose fines and give credits. Most of these fines and credits on the Metropolitan are small, from two to ten per cent. An attempt was made at one time to fix a regular schedule of fines for the breaking of the various rules, but this was given up as impracticable because the circumstances vary so much in each case. Fines are always made heavier if a man has had warning a short time before his offense. Thus if John Jones is fined 2 per cent. this week for too high speed on a curve, and John Smith is reported for the same offense next week, John Smith will be fined 4 per cent., because he had a warning such a short time previous. The

same system is used for the promotion of the station agents, both men and women.

To sum up, it may be said that the principal advantages of the system are: (1) It holds out promotion by merit as an incentive to good service rather than the lower incentive of the fear of punishment.

(2) The fact that merit is tangibly recognized is an inducement to special effort, which special effort would not be made were the employé's aim simply to keep from getting suspended or discharged until promoted by the age of service rule.

(3) It puts the best men in the best positions regardless of age of service.

Discharges are made only when an employé of any rank maintains such a low per cent. that it is evident that he is not suited for the position.

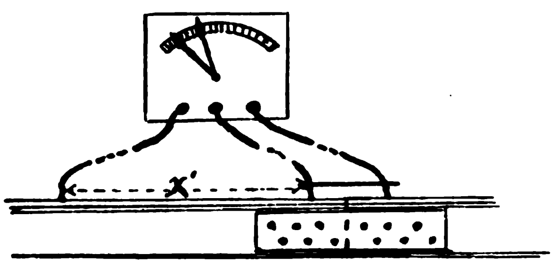
MEASURING RAIL JOINT RESISTANCES.

BY W. N. WALMSLEY.

The instrument for measuring rail joint resistances described in The Electrical Engineer of October 21, brings to my mind one proposed by myself to be used on the Fairmount Park Transportation Company's road, Philadelphia, last year, but which was abandoned when it was decided to make tests with no current on the line, using a storage cell with ammeter and milli-voltmeter.

The scheme as proposed was to find the joint resistances in terms of rail length, and under actual running conditions, and for the purpose was to be used a millivoltmeter with two pointers influenced by independent solenoids reading direct on the same scale.

One circuit embraced the resistance of the rail joint, the terminals being a positive distance apart, as shown in the



MEASURING RESISTANCE OF RAIL JOINTS.

accompanying sketch. The other circuit measured a variable distance on the rail, one terminal to be moved along until the two pointers read alike. The joint then would have the same resistance as this length of rail.

As the same current would influence each of these readings it could be ignored, and in order to find the exact drop a table may be made by finding resistance and drop of various sections of rail per foot in the station, and comparing the length found as above, with the table.

The leaks to ground may also be ignored for it would be uniform within such a short space, unless the joint resistance was very high, in which case it should be examined at once.

THREE PHASE ELECTRIC RAILWAY UP THE GORNERGRAT, SWITZERLAND.

THE first trial trips on the electric railway up the Gorner Grat near Zermatt were carried out last month in the presence of the Inspectors of the Swiss Railway Department. The section already completed has a length of 1,600 meters and a gradient of 12 per cent.

The tests gave complete satisfaction, both the ascent and descent of this gradient being effected without the slightest difficulty, the motors holding the locomotive perfectly to its proper speed. Starting on the maximum gradient with a fully loaded train was also effected with great facility.

It will be remembered that this is a rack railway, the total length being 6½ miles and the maximum gradient 20 per cent. The power is derived from the Findelenbach, which drives four turbines of 250 h. p. each, coupled directly to three-phase alternators of 5,000 volts and 40 cycles. Transformers are placed in the power house itself for feeding the line as it passes the building and two other transformer stations are provided. The e. m. f. of the trolley line is 550 volts. Each locomotive is equipped with two three-phase motors of 90 h. p. each, driving the main pinions by spur-gear. Owing to the property of three-phase motors, by which they will act as generators and take up the full power which they are designed to give out as motors, when driven at two or three per cent. above the speed of synchronism, the locomotive will, in descending, give power back to the line. In case only descending trains should be on the line, the surplus power will be taken up in a water resistance in the power house.

The contractors for the whole of the electrical equipment are Messrs. Brown, Boveri & Co., who, in the well-known Lugano tramway, were the first to apply the three-phase system directly to traction. They have also supplied the electrical parts of the locomotives for the Jungfrau railway, where their system is to be adopted, and are now engaged on the equipment of the line from Stansstaad to Engelberg, which is to be running next Spring.

The standard gauge line from Burgdorf to Thun in Canton Bern is also to be equipped by them on the three-phase system, the power being taken from the power station on the Kander.

ELECTRIC LIGHTING

THE METER QUESTION.

BY GEORGE L. THAYER.

A CORRESPONDENT signing himself "Station Manager," in a recent issue of The Electrical Engineer takes perhaps an extreme view against meters. Mr. Schuchardt in a previous article holds that all current ought to be metered, and "Station Manager" prefers flat rates. There is no doubt that flat rates are very attractive to both station and consumer, and it is perhaps easier to meet the general run of competition with contract rates. This much may be said in favor of them. Given a consumer on a meter rate and one on flat rate: The income from the first may vary within wide limits depending upon the number of hours use per light. The main difference in cost to the station will be the saving in fuel, a comparatively small amount. The income from the second is fixed and his variation in use of current is likewise a difference in fuel used. Hence with variation in current furnished, maximum load remaining the same, the margin of profit on flat is more constant than on meter rates. In the case of flat rates we always have waste, running from 10 to 50 per cent. of total current supply.

If the useless burning of lights could be done away with, a contract system with a time limit for burning would be very satisfactory. Another difficulty remains, that of dealing with the dark corners of stores where light is needed several hours per day more than the general run of lamps. It is impossible to make a really satisfactory rate. The consumer will underestimate the extra amount of light used. You will wish to please him with as low a rate as possible. By and bye he will compare notes with another of your customers and there will be trouble, some explanations, and rates go down another peg.

An account of what the writer has done on his plant may offer a suggestion towards a way of avoiding some of the disadvantages of a purely contract system. We are operating at Belle Plaine, Ia., under a franchise which states that incandescent lamps shall be 60 cents per month burning until midnight or one cent per hour on meter. A straight meter rate is not satisfactory as the revenue is liable to vary considerably. If the bills average much above 65 cents per month there is complaint. If it falls to 50 cents and less the company is the loser and the meter rate cannot be raised without engendering dissatisfaction on the part of the customer. At the present time when a new customer comes to us we give him a flat rate of 60 cents per month for each lamp in use. If he has some lamps used only at times and does not wish to pay full rates he is given a combination contract and meter rate. He pays 33 cents per month for each lamp burning during the hours of maximum load on the plant and 5 cents per k. w. hour for all current taken. We use a 3.3 watt lamp.

The plan has several advantages. In the first place the winter bill will not exceed the average by 50 to 100 per cent. and experience shows that you can get more per year out of a customer if the monthly bills are not subject to wide variation. The consumer remembers the high winter bill, but forgets the low summer one. The meter charge of a quarter of a cent per hour is a sufficient incentive for the economical use of current. If at certain seasons his consumption of current is largely increased by reason of cloudy days or later hours of closing, the meter rate is sufficient to cover the extra expense incurred at the station. In the case of hotels or other concerns using

lamps which burn from 1 to 15 hours per day, the station can make a closer rate by this than by any other system of charging, because the revenue from each lamp under widely varying hours of use is more nearly proportinal to the expense incurred by the station in running it. It can hardly be used for churches, lodges, etc., whose use of current is intermittent, or with residences, unless a Wright demand meter is installed, when a high and a low meter rate will probably give better satisfaction.

3.3 watt lamp; 26 nights per month:

Flat rate 33c.; current 5c. per k. w. hour.

Time limit.	Hours daily.	Rent.	Total charges. Summer.	Average.	Winter.	Equivalent meter rates.
7	1	33	33	40	50	29c.
8	2	33	37	47	57	17c.
9	3	33	44	54	64	13c.
10	4	33	51	61	71	11c.
12	6	33	64	74	85	9c.
All night.	12	33	105	116	126	7c.

The above table gives the estimated revenue to be derived from such a system of rates. Cloudy days and winter mornings are not included and will slightly increase the revenue per lamp. As most of our stores close at 9:30 p. m. their bill is practically the same as our flat rate of 60 cents per month. The meter rate of 5 cents per k. w. hour is about the lowest that could be made and still bring a paying revenue for extra lighting on dull winter days, and yet require stores closing at 9 o'clock and earlier to pay as close to the regular flat rate as is possible.

Although the system is still something of an experiment, the experience of nearly a year has been highly satisfactory. It seems to have solved some otherwise difficult problems.

MUNICIPAL LIGHTING OWNERSHIP FROM THE STOCKHOLDER'S STANDARD.

BY W. H. FITZGERALD.

IT seems a little late in the day to discuss the public lighting question as regards Detroit, and I would not attempt it except for the reason that I believe a proper understanding of the question may prevent other cities from following our example. For a number of years the public lighting of this city was done by private corporations and until the tide of feeling favoring municipal ownership of everything struck us, the service given the public was generally satisfactory.

The writer has refrained from writing anything on the subject for some time, as he recognized it as one of those evils that must wear itself out. Nevertheless, he has labored industriously to lay the facts before the public and private officials in many cities throughout the country regarding the lighting of Detroit and the circumstances leading up to the adoption of municipal ownership. Whether his efforts have been of any service to either existing companies or municipal corporations, the fact that this city is so far the last large one to adopt the plan of doing its own lighting affords some satisfaction. The Electrical Engineer's recent editorial comments on the letters of Mr. J. L. Hudson, president, and Mr. Ford Starring, secretary of the Detroit Lighting Commission, are such as to leave further notice unnecessary. The letter of the secretary need only be read by any practical man to recognize its worth. Now, as regards the question, "Have not the people of a municipality the right to go into the lighting business if they see fit?" The general verdict seems to be that they have. But there is a question of justice involved which should not be lost sight of. When the City of Detroit decided to enter into the business of furnishing its own light, the Detroit Electric Light and Power Company, the contractors for supplying the lighting of the city, had $650,000 invested in its public lighting plant. The investors of this large amount of capital were and are among Detroit's largest taxpayers. These taxpayers had invested their money in good faith and had perfected at their own expense a system of street lighting now in use by the city. Notwithstanding these facts, the company were unable to sell one cent's worth of dynamos, lamps, lines, etc., although the apparatus which was in use is considered by users generally to be much superior to that purchased by the city. The owners of this large amount of property share the additional burden of taxation to supply the city the means with which to enter into competition with themselves. This is rank injustice, and I trust that no body of enterprising citizens in any community will ever be placed in such a position as to have their property thus sacrificed for the political advancement of demagogues.

This city did not embark in the lighting business because of poor service rendered by the contracting company, nor for the reason that the city could not get its lighting cheaply; but because of the prevailing sentiment in favor of municipal ownership of that time, helped along by members of a lighting company who did the public lighting before the Detroit Light and Power Company came into existence. And when the authority was finally granted the city, the mayor named as the first lighting commission the stockholders of the old company and their friends.

How could it be expected then that under such unfair treatment, the service furnished by the contracting company would be anything but unsatisfactory to the Public Lighting Commission? The lighting of this city is costing more at present than the same service can be obtained from private corporations. It will continue to cost more as the apparatus becomes worn, necessitating more extensive repairs, and working with less economy until finally abandoned. There are many items of expense in connection with the cost of our public lighting which the commission omit or underestimate and the largest of which is not that of taxes which would amount to at least three dollars per lamp per annum if the plant were owned by a private corporation.

ROCK FALLS, ILL. MUNICIPAL PLANT IN DIFFICULTIES.

THE subjoined report just issued is signed by Mr. L. L. Emmons, Sr.:

A financial statement of the Rock Falls Electric Light Plant from May 1, 1895, to November 31, 1897, as shown by the official proceedings of the City Council of Rock Falls, and which includes the cost, operating expenses, repairs, interest on its capitalization and depreciation, engineer service, printing, its extension, insurance, permanent improvement, and all incidental expenses connected with construction and operation:

Rock Falls E. L. Plant in account with the City of Rock Falls:

DEBTOR.	
To aggregate amount of bills allowed by the City Council on account of E. L. Plant	$20,900.00
Estimated cost of repairs contracted for by the City Council at present writing	1,000.00
Interest and depreciation on the plant on the basis of Mayor Ward Lincoln's estimate	3,314.00
Salary of E. L. Collector	208.33
Total expenditures	$25,422.33
CREDITOR.	
We credit the Electric Light Plant with its capitalization, as capitalized by Mayor Ward Lincoln	$10,197.22
Arc light service	3,250.00
Incandescent E. L. collections from installation of the plant to Nov. 31, 1897, which includes the collections on meters sold by the city, as shown by the city treasurer's books	4,092.08
Supplies sold	275.93
Permanent improvements (estimated)	600.00
Other cash items	107.93
Total credits	$18,523.16
Grand total of expenditures	$25,422.33
Grand total of credits	18,523.16
Expenditures over receipts	$6,899.17

The deficiency will have to be taken from the 2 per cent. tax levy levied for the operating expenses of the city.

Any one taking the trouble to figure will see that in order to make the plant self-sustaining, the rates for sixteen candle-power should be fixed at not less than forty cents; rates for meters and other takers of lights correspondingly.

We are under obligations to Philip Davis, our efficient City Treasurer, for an itemized statement of electric light collections, including meters sold from the installation of the plant to November 31, 1897.

The Sterling Gas and Electric Light Company, of Sterling, Ill., across the river, offered to furnish street lighting for Rock Falls at $1,020 per year.

"I FIND a great deal of valuable information in The Electrical Engineer, especially on street lighting."—J. H. Andrews, Reed City, Mich.

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ARE PROFESSIONS MERELY TRADES TO-DAY?

JUDGE PATTERSON, of the New York Supreme Court, has made no little sensation among the members of the legal profession by a recent utterance declaring that legal practice had degenerated into a mere trade, and that the lawyers of to-day are small men, because there is no call for large ones. He told the Delta Phi Club that the profession had sadly degenerated since the days when he was at the bar, and he took an altogether pessimistic view of the situation.

While lawyers are discussing this latest exhibition of the tendency to glorify the days that are past at the expense of the present, men in other professions have been invited to express opinions about their own fields of work. It is interesting to note that they all are inclined to regard the standards of to-day as higher than they once were. If any uncertainty exists it appears to be about the church, and even there the criticism applies rather to oratorical power in the pulpit than to zeal for the salvation of souls or love for the sick and sorrowful.

When we turn to electrical engineering, it must be apparent to all that the professional standard is infinitely higher than ever before. Indeed it is striking that a branch so young has developed thus quickly ideals of its own and tests of merit that are in nowise below those of the other kindred professions. In merely technical matters, electrical engineering, properly so called, stands at the very front in its insistence on precision and exactitude; and its units, all the creation of late years, are not to be surpassed for refinement of qualitative and quantitative value. In broader matters, there is a marked tendency to separate consultative from commercial work, and to limit and define professional lines of occupation. Considering the fact that a few years ago, there were no college degrees in electrical engineering, and few classes for its study, it is remarkable that the standard of attainment is in general so high; and it is by no means lowest amongst the men who jumped from their telegraph keys to lead the advance into all the newer fields of electrical industry. Moreover it is an open and well known fact that the American Institute of Electrical Engineers has steadily been raising its requirements for membership, and more and more expects and demands the performance of good professional work as a fundamental reason for the honor. There is no profession, and there has never been a time, in which the quack and the charlatan stood less chance of success, in spite of the determination of the public to concede no real greatness to an electrical engineer unless he will perform miracles for them.

So far from the professions becoming trades, we should say that the trades are daily rising also in their ideals of merit, and approaching in the skill and knowledge of their best practitioners the degree of ability once deemed sufficient for earning a livelihood in the professions.

SPARKING.

IN spite of the predictions of our alternating current friends, vouchsafed some time ago, that the commutator would soon be a thing of the past and that the matter of sparking need, therefore, no longer occupy seriously the attention of dynamo designers, the fact remains that the commutator is still with us and bids fair long to remain so, if for no other purpose than to rectify the current for exciting the fields of the alternating machine which was designed to exterminate the commutator. Hence even the alternating partisans will have to admit that there is still use for the commutator; while the increasing use of the rotary converter would make it appear that the commutator was on the rise, instead of on the decline. The commutator is still evidently worth discussing, and all the phenomena connected with its function. The chief phenomenon, and perhaps the only one with which it is necessary to deal in the construction and design of a machine, is sparking. Rivers of ink have flowed in the discussion of this question, and still one might say that absolute finality in the discussion has not been reached, although almost absolute perfection has been reached in the suppression of sparking. Such being the fact, present discussions on the subject of the cause and effects of sparking would be reduced to a discussion of the details or design of actual machines in which sparking has been practically suppressed, and this method has indeed been followed in the brief but pithy paper which Mr. Thorburn Reid read last week before the American Institute of Electrical Engineers. As Mr. Reid pointed out, the present theories on sparking differ materially from those of twenty years ago, when the angle of lag and lead played such a prominent part in the treatment of this topic. The discussion has for some time past been based on the recognition of the great obstacle to perfect commutation, the reactance of the coil under commutation; and to the further recognition that the duty of overcoming this reactance must be effected by the e. m. f. set up by the cutting of the lines from the field by the coil under commutation; as well as the fact that this must be limited by the available reversal e. m. f. Mr. Reid devoted considerable space in his paper to show that the theory above mentioned, though a great step in advance, stopped just short of a complete explanation of the phenomena involved, owing to the erroneous idea that injurious sparking was due to the current sparking across the gap between the brush and the receding segment, by reason either of incomplete reversal of the current, or of over reversal. Mr. Reid's main object, therefore, was to show that sparking from either of these causes may be harmless, and that the real injury is done before the segment leaves the brush. Without going into the details of the analysis presented by Mr. Reid we may state the results as given by him, namely, that perfect commutation consists of a complete reversal of the current in the coil under commutation in such a manner that the portions of the current flowing through the two segments to each end of the coil connected shall be proportional to the respective contact areas of the segments. Mr. Reid showed the various

ways in which imperfect commutation may occur and the manner in which it causes injury to the commutator. This includes the explanation of the fact, frequently observed, that one class of sparking has no deleterious effect, while the other rapidly destroys the commutator. It also explains the case in which a machine runs perfectly sparkless when first set up, but after a time commences to spark and continues to do so until the commutator is trued up again. Mr. Reid then shows that there are two ways by which sparkless commutation may be assured. First by increasing the brush contact resistance, and second, by decreasing the impedance of the coil under commutation. The limitations of the second of these conditions are merely those of economical design, lowering of the inductance below a certain point, and increasing the cost of the machine; whereas the limitation of the first condition is that of rise of temperature of the commutator. The increasing use of the carbon brush in place of the copper brush is explained by Mr. Reid by the fact that the contact resistance of carbon on copper per square inch is much greater than that of copper on copper. Mr. Reid claims, however, that by properly proportioning the contact areas and inductance, commutating machines may be designed to run as cool with copper brushes as with carbon. Perfect commutation can only be practically secured, however, by making the impedance of the coil negligible as compared with the contact resistances and this theory, according to Mr. Reid, is the result of a comparison of the sparking constants of a large number of machines. The discussion which followed Mr. Reid's paper tended to confirm Mr. Reid's theory, and some valuable information on commutator design was given by Mr. Gano S. Dunn, who described a very ingenious method of obtaining the reactance factor in coils under commutation. Mr. C. P. Steinmetz stated that at the General Electric factory commutators are designed on the basis of watts per square inch, and not on the old basis of a given current density per square inch area.

GOOD ELECTRICAL INVESTMENTS.

THE figures of American Bell Telephone dividend are certainly remarkable. It has just been figured out that the last extra dividend on the stock makes 63 per cent. of extra since 1884, while the regular dividends have run for years from 12 up to 18 per cent. In other words, the bulk of the stock has earned somewhere around 200 per cent., and is to-day quoted at about 260. That is not a bad showing in one line of electrical endeavor, for it must be borne in mind that the sub-companies have for the most part been earning good dividends for years past. It was not always so, and the parent stock before the Drawbaugh decision could be had for less than 150. In the early days, when Mr. Hubbard, recently deceased, many times a millionaire, was trying to build up Bell telephone interests, the stock could be had at anybody's price, but nobody wanted it.

Legitimate electrical investment has not done so badly for its clientage. Western Union Telegraph dividends come along with the regularity of clock work, the submarine cable companies are doing well; and Commercial Cable, with its absorbed Postal, is at a high figure and paying bonus dividends. So, too, with electric lighting. All the large local companies that have been well handled and have kept up with the times, are doing well, and setting an example their parent companies would be delighted to imitate. A typical case is New York Edison, which during the past year, for eleven months, has a gross income of $2,205,630 or $204,000 more than the same period last year, and with a correspondingly solid gain in the net. Evidently electric lighting is bettering every day.

Turning to electric railway work, the roads are to a great extent beginning to show their emergence from bad times, and earnings are coming up. That earnings and profits in that line will be larger in 1898 than for a long time past seems beyond doubt, and values of street railway stock and bonds are destined to exhibit advances all along the line. The over-capitalized roads have already succumbed or been pruned, and even this class of depreciated property is in better condition to earn dividends for the cash actually put in. It is not unusual to hear that roads have been over-built, but against that undeniable fact must be set the incontestable truth that there is hardly a city of any magnitude in the world to-day, and certainly not one in the United States, where the facilities for travel are equal to the demand.

ELECTRIC LOCOMOTIVES AT STEAM TERMINALS.

COMMENT has been made more than once in these columns on the desirability of electric locomotives at the termini of steam roads upon which the adoption of electric power in general is still a remote proposition. We are glad to note that this idea is likely of adoption in the fine new Union depot for Boston. It is said that no steam locomotives will come within a mile of it, all of them dropping their trains or picking them up outside the electric limits. This will surely be a gain in many important respects, and the example is one worthy of imitation not only in this country but abroad. Railway depots of large systems are frequently very fine, ornate, and expensive buildings, but any long stay in their vicinity or within their precincts is a most distasteful ordeal, due entirely to the presence of the bye-products of the combustion of the locomotive fuel. Going into some of them, the sulphur, and other fumes, often literally make one gasp; while all the decorations tend to rapid decay. Where the approach is made through a tunnel, which is a common thing, the added suffocation is serious. To-day, there is absolutely no need to use steam locomotives within depots or for that matter within urban limits. They are an anachronism and a nuisance, and all their merits for long hauling do not excuse or warrant such use any longer.

WOMEN AND ELECTRICITY.

THE inability of most women to learn or comprehend anything about electricity is at all times painfully apparent. Women can succeed in mastering pretty well all the arts and sciences, but when it comes to electricity they let it severely alone—with such rare exceptions as Mrs. Hertha Ayrton and Miss Bertha Lamme, and ——? It is stated that at Milford, Del., at the Sussex County Teachers' Institute held in that city last week a lady teacher boarding at the Windsor Hotel tried to blow out the electric light. Being unable to blow it out, she wrapped a skirt around it, but the skirt would not stay, so she tried to fan it out, and in her exertion struck it, and it broke. She succeeded. Now that is just what you might have expected of a jay hayseed farmer, provided he wore a skirt, but this was a teacher! Women fight shy of electrical knowledge, and even when employed in electrical work do not follow the lines that require technical familiarity with the subject. Recently a woman applied for a position out in Jersey as motorman on a trolley car. We inquired of the manager of the road if he had taken the applicant into their employ, whereupon he replied: "Not on your life." We are disappointed. It would at least have been a good "ad" for the road. But perhaps the management stood in fear of a heavy average of accidents and repairs on that car.

MECHANICAL

THE COMPARATIVE COST OF STEAM AND ELECTRIC POWER.—IV.

BY IRVING A. TAYLOR.

In order to arrive at the fuel and water costs we shall have to determine their consumption. The steam consumption, taken at 80 pounds boiler pressure, at fractional load, is calculated by a formula taken from Prof. R. C. Carpenter's paper, Transactions of the American Inst. of E. E., May, 1893, the formula, $y = P + b\sqrt{\frac{m}{n}}$ being chosen on account of its simplicity. The mechanical efficiency of the engines is calculated from Prof. Hrabák's approximate formula, page 205, 1st edition, of "Practical Electrical Engineering." The internal friction of the engines is taken as constant according to Prof. Thurston's determinations. The steam consumption of the pumps is calculated from formulæ based on the results of Chas. E. Emery, Ph. D., as stated in the "Report and Awards, Group XX., U. S. Centennial Exposition." The other data are taken from a large number of the best sources. The boiler evaporations are lower than can be obtained in special tests, but represent good, ordinary practice. The steam plant must be kept in first class repair in order to attain the economies which follow, as they represent pretty good practice.

In Tables 3, A, B, C, D, E, F, G, H and I, will be found the yearly fuel and water costs, with all the items by which they have been obtained. It will be remembered that the designations, "Case I."' "Case II.," and "Case III.," refer to the three different classes of load factors. Each of these tables is carried out first with coal at $2 per ton; then, starting from the items @ $4 per ton, the details and costs are followed out with coal at $4 per ton. The evaporation will be about six pounds of water per pound of coal, for the $2 coal, and eight pounds of water per pound of coal for the $4 coal. This, of course, is bound to vary, but represents pretty good practice, and so will be used in figuring the "tons of coal per year" in Tables 3 A, B, C, etc.

Having in these tables determined the fuel and water costs, we will, in Tables 4, A, B and C, sum up the various costs in the order in which we have calculated them, and thereby obtain the total costs per year. Dividing the total costs by the number of horse-power hours of energy delivered per year, which is equal to 3,080 hours, x the load factor (a proper fraction or unity) x the brake horse-power of the engine in the case considered, and multiplying by 100, we obtain the costs per horse-power hour in cents.

TABLE 3A.—FUEL AND WATER COSTS.

CASE I.

B. H. P. of engine	10	25	50	100
I. H. P. of engine	14.3	32.5	61	116.2
Mechanical efficiency of engine	.70	.77	.82	.86
Lbs. of steam per I. H. P. H.	43	39	35	33
Lbs. of steam per B. H. P. H.	61.4	50.7	42.7	38.4
Lbs. steam per hour, engine	614.	1,265	2,130	3,840
Lbs. steam per hour, pump	14	28	46	82
Lbs. steam, leakage and condens.	75	129	174	275
Tot. steam per hour, in lbs.	703	1,422	2,350	4,197
H. P. of boiler, allowing 15% surplus.	27	55	90	160
Tons coal per year @ $2	161	326	539	962
Tons coal per year for standby losses	11	23	38	68
Tot. tons coal per year @ $2	172	349	577	1,030
Cost of coal per year @ $2	$344	$698	$1,154	$2,060
Removal of ashes	$9	$17	$29	$51
Water cost per year	$35	$70	$116	$207
Fuel and water per year; coal @ $2.	$388	$785	$1,299	$2,318
Tons of coal per year @ $4	121	245	405	722
Tons coal per year for standby losses	11	23	38	68
Tot. tons coal per year @ $4	132	268	443	790
Cost of coal per year @ $4	$528	$1,072	$1,772	$3,160
Removal of ashes	$7	$13	$22	$40
Water cost per year	$35	$70	$116	$207
Fuel and water per year; coal @ $4.	$570	$1,155	$1,910	$3,407

TABLE 3B.—FUEL AND WATER COSTS.

CASE II.

Engine of 10 B. H. P. and 14.3 I. H. P. at full load, 4.3 friction H. P. at all loads. Boiler of 27 nominal H. P.

B. H. P. output	3	5	8	
I. H. P. input	7.3	9.3	12.3	
Lbs. of steam per I. H. P. hour	52.3	48.6	44.8	
Lbs. steam per hour, engine	382	451	551	
Lbs. steam per hour, pump	9	10	12	
Lbs. steam, leakage and condens.	75	75	75	
Tot. lbs. steam per hour	466	536	638	
Hours per day at above rate	5	3	2	
Tot. lbs. steam per day	2,330 +	1,608 +	1,276	= 5,214
Tons coal per year @ $2				120
Tons coal per year, standby losses.				11
Tot. tons coal per year @ $2				131
Cost of coal per year @ $2				$262
Removal of ashes				$6
Water cost per year				$26
Fuel and water per year; coal @ $2.				$294
Tons of coal per year @ $4				90
Tons of coal per year, standby losses				11
Tot. tons of coal per @ $4				101
Cost of coal per year @ $4				$404
Removal of ashes				$5
Water cost per year				$26
Fuel and water per year; coal @ $4.				$435

TABLE 3C.—FUEL AND WATER COSTS.

CASE II.

Engine of 25 B. H. P. and 32.5 I. H. P. at full load, 7.5 friction H. P. at all loads. Boiler of 55 nominal H. P.

B. H. P. output	7.5	12.5	20	
I. H. P. input	15	20	27.5	
Lbs. steam per I. H. P. hour	48.1	44.3	40.7	
Lbs. steam per hour, engine	772	886	1120	
Lbs. steam per hour, pump	17	20	25	
Lbs. steam, leakage and condens.	129	129	129	
Total lbs. of steam per hour	868	1,035	1,274	
Hours per day at above rate	5	3	2	
Total lbs. steam per day	4,340 +	3,105 +	2,548	= 9,993
Tons of coal per year @ $2				229
Tons of coal per year, standby losses				23
Total tons coal per year @ $2				252
Cost of coal per year @ $2				$504
Removal of ashes				$11
Water cost per year				$50
Fuel and water per year; coal @ $2.				$565
Tons of coal per year @ $4				172
Tons of coal per year, standby losses				23
Total tons of coal per year @ $4				195
Cost of coal per year @ $4				$780
Removal of ashes				$9
Water cost per year				$50
Fuel and water per year; coal @ $4.				$839

TABLE 3D.—FUEL AND WATER COSTS.

CASE II.

Engine of 50 B. H. P. and 61 I. P. H. at full load, 11 friction H. P. at all loads. Boiler of 90 nominal H. P.

B. H. P. output	15	25	40	
I. H. P. input	26	36	51	
Lbs. steam per I. H. P. hour	43.2	39.6	36.4	
Lbs. steam per hour, engine	1,122	1,425	1,856	
Lbs. steam per hour, pump	26	32	40	
Lbs. steam, leakage and condens.	174	174	174	
Total lbs. steam per hour	1,322	1,631	2,070	
Hours per day at above rate	5	3	2	
Total lbs. steam per day	6,610 +	4,893 +	4,140	= 15,643
Tons of coal per year @ $2				359
Tons of coal per year, standby losses				38
Total tons of coal per year @ $2				397
Cost of coal per year @ $2				$794
Removal of ashes				$20
Water cost per year				$77
Fuel and water per year; coal @ $2.				$891
Tons of coal per year @ $4				269
Tons of coal per year, standby losses				38
Total tons of coal per year @ $4				307
Cost of coal per year @ $4				$1,228
Removal of ashes				$15
Water cost per year				$77
Fuel and water per year; coal @ $4.				$1,320

TABLE 3E.—FUEL AND WATER COSTS.

CASE II.

Engine of 100 B. H. P. and 116.2 I. H. P. at full load, 16.2 friction H. P. at all loads. Boiler of 160 nominal H. P.

B. H. P. output	30	50	80	
I. H. P. input	46.2	66.2	96.2	
Lbs. steam per I. H. P. hour	40.8	37.3	34.3	
Lbs. steam per hour, engine	1,882	2,470	3,300	
Lbs. steam per hour, pump	43	54	71	
Lbs. steam, leakage and condens.	275	275	275	
Total lbs. of steam per hour	2,200	2,799	3,646	
Hours per day at above rate	5	3	2	
Total lbs. of steam per day	11,000 +	8,397 +	7,292	= 26,680
Tons of coal per year @ $2				612
Tons of coal per year, standby losses				68
Total tons of coal per year @ $2				680
Cost of coal per year @ $2				$1,360
Removal of ashes				$34
Water cost per year				$132
Fuel and water per year; coal @ $2.				$1,526
Tons of coal per year @ $4				459
Tons of coal per year, standby losses				68
Total tons of coal per year @ $4				527
Cost of coal per year @ $4				$2,108
Removal of ashes				$26
Water cost per year				$132
Fuel and water per year; coal @ $4.				$2,266

TABLE 3F.—FUEL AND WATER COSTS.

CASE III.

Engine of 10 B. H. P. and 14.3 I. H. P. at full load, 4.3 friction H. P. at all loads. Boiler of 27 nominal H. P.

B. H. P. output	1.	1.5	4.
I. H. P. input	5.3	5.8	8.3
Lbs. steam per I. H. P. hour	58	56.3	50.3

Lbs. steam per hour, engine..........	307	327	417	
Lbs. steam per hour, pump..........	8	8	10	
Lbs. steam, leakage and condens....	75	75	75	
Total lbs. of steam per hour..........	390	410	502	
Hours per day at above rate..........	4	4	2	
Total lbs. of steam per day..........	1,560 +	1,640 +	1,004	= 4,204
Tons of coal per year @ $2..........				96
Tons of coal per year, standby losses				11
Tons of coal per year @ $2..........				107
Cost of coal per year @ $2..........				$214
Removal of ashes..........				$5
Water cost per year..........				$21
Fuel and water per year; coal @ $2..				$240
Tons of coal per year @ $4..........				72
Tons of coal per year, standby losses				11
Total tons of coal per year @ $4.....				83
Cost of coal per year @ $4..........				$332
Removal of ashes..........				$4
Water cost per year..........				$21
Fuel and water per year; coal @ $4..				$357

TABLE 3G.—FUEL AND WATER COSTS.
CASE III.

Engine of 25 B. H. P. and 32.5 I. H. P. at full load, 7.5 friction H. P. at all loads. Boiler of 55 nominal H. P.

B. H. P. output..........	2.5	3.75	10.	
I. H. P. input..........	10	11.25	17.5	
Lbs. steam per I. H. P. hour..........	54.5	52.5	46.	
Lbs. steam per hour, engine..........	545	590	804	
Lbs. steam per hour, pump..........	13	14	19	
Lbs. steam, leakage and condens....	129	129	129	
Total lbs. steam per hour..........	687	733	952	
Hours per day at above rate..........	4	4	2	
Total lbs. steam per day..........	2,748 +	2,932 +	1,904	= 7,584
Tons of coal per year @ $2..........				174
Tons of coal per year, standby losses				23
Total tons of coal per year @ $2.....				197
Cost of coal per year @ $2..........				394
Removal of ashes..........				$10
Water cost per year..........				$38
Fuel and water per year; coal @ $2..				$442
Tons of coal per year @ $4..........				130
Tons of coal per year, standby losses				23
Total tons of coal per year @ $4.....				153
Cost of coal per year @ $4..........				$612
Removal of ashes..........				$8
Water cost per year..........				$38
Fuel and water per year; coal @ $4..				$658

TABLE 3H.—FUEL AND WATER COSTS.
CASE III.

Engine of 50 B. H. P. and 61 I. H. P. at full load, 11 friction H. P. at all loads. Boiler of 90 nominal H. P.

B. H. P. output..........	5.	7.5	20.	
I. H. P. input..........	16.	18.5	31.	
Lbs. steam per I. H. P. hour..........	49.6	47.5	41.2	
Lbs. steam per hour, engine..........	793	878	1,278	
Lbs. steam per hour, pump..........	19	21	29	
Lbs. steam, leakage and condens....	174	174	174	
Total lbs. of steam per hour..........	986	1,073	1,481	
Hours per day at above rate..........	4	4	2	
Total lbs. of steam per day..........	3,944 +	4,292 +	2,962	= 11,198
Tons of coal per year @ $2..........				257
Tons of coal per year, standby losses				38
Total tons of coal per year @ $2......				295
Cost of coal per year @ $2..........				$590
Removal of ashes..........				$15
Water cost per year..........				$55
Fuel and water per year; coal @ $2..				$660
Tons of coal per year @ $4..........				192
Tons of coal per year, standby losses				38
Total tons of coal per year @ $4......				230
Cost of coal per year @ $4..........				$920
Removal of ashes..........				$12
Water cost per year..........				$55
Fuel and water per year; coal @ $4..				$987

TABLE 3I.—FUEL AND WATER COSTS.
CASE III.

Engine of 100 B. H. P. and 116.2 I. H. P. at full load, 16.2 friction H. P. at all loads. Boiler of 160 nominal H. P.

B. H. P. output..........	10	15	40	
I. H. P. input..........	26.2	31.2	56.2	
Lbs. steam per I. H. P. hour..........	47.7	45.4	38.8	
Lbs. steam per hour, engine..........	1,250	1,417	2,180	
Lbs. steam per hour, pump..........	30	34	49	
Lbs. steam, leakage and condens....	275	275	275	
Total lbs. steam per hour..........	1,555	1,726	2,504	
Hours per day at above rate..........	4	4	2	
Total lbs. steam per day..........	6,220 +	6,904 +	5,008	= 18,132
Tons of coal per year @ $2..........				416
Tons of coal per year, standby losses				68
Total tons of coal per year @ $2.....				484
Cost of coal per year @ $2..........				$968
Removal of ashes..........				$24
Water cost per year..........				$90
Fuel and water per year; coal @ $2..				$1,082
Tons of coal per year @ $4..........				312
Tons of coal per year, standby losses				68
Total tons of coal per year @ $4......				380
Cost of coal per year @ $4..........				$1,520
Removal of ashes..........				$19
Water cost per year..........				$90
Fuel and water per year; coal @ 4..				$1,629

TABLE 4A.—TOTAL COST OF STEAM POWER.
CASE I.

Coal at $2 per ton.

B. H. P. of engine..........	10	25	50	100
Labor..........	$468	780	936	1,560
Supplies..........	$37	78	128	200
Plant charges..........	$438	657	936	1,426
Fuel and water..........	$388	785	1,299	2,318
Total costs per year..........	$1,331	2,300	3,299	5,504
H. P. hours per year..........	30,800	77,000	154,000	308,000
Costs per H. P. hour, cents..........	4.32	2.99	2.14	1.79

Coal at $4 per ton.

B. H. P. of engine..........	10	25	50	100
Labor..........	$468	780	936	1,560
Supplies..........	$37	78	128	200
Plant charges..........	438	657	936	1,426
Fuel and water..........	$570	1,155	1,910	3,407
Total costs per year..........	$1,513	2,670	3,910	6,593
H. P. hours per year..........	30,800	77,000	154,000	308,000
Costs per H. P. hour, cents..........	4.92	3.47	2.54	2.14

TABLE 4B.—TOTAL COST OF STEAM POWER.
CASE II.

Coal at $2 per ton.

B. H. P. of engine..........	10	25	50	100
Labor..........	$390	585	780	936
Supplies..........	$37	78	128	200
Plant charges..........	$438	657	936	1,426
Fuel and water..........	294	565	891	1,526
Total costs per year..........	$1,159	1,885	2,735	4,088
H. P. hour per year..........	14,168	35,420	70,840	141,680
Costs per H. P. hour, cents..........	8.18	5.33	3.86	2.89

Coal at $4 per ton.

B. H. P. of engine..........	10	25	50	100
Labor..........	$390	585	780	936
Supplies..........	$37	78	128	200
Plant charges..........	$438	657	936	1,426
Fuel and water..........	$435	839	1,320	2,266
Total costs per year..........	$1,300	2,159	3,164	4,828
H. P. hour per year..........	14,168	35,420	70,840	141,680
Costs per H. P. hour, cents..........	9.19	6.1	4.47	3.41

TABLE 4C.—TOTAL COST OF STEAM POWER.
CASE III.

Coal at $2 per ton.

B. H. P. of engine..........	10	25	50	100
Labor..........	$390	585	780	936
Supplies..........	$37	78	128	200
Plant charges..........	$438	657	936	1,426
Fuel and water..........	$240	442	660	1,082
Total costs per year..........	$1,105	1,762	2,504	3,644
H. P. hour per year..........	5,544	13,860	27,720	55,440
Costs per H. P. hour, cents..........	20.	12.72	9.05	6.57

Coal at $4 per ton.

B. H. P. of engine..........	10	25	50	100
Labor..........	$390	585	780	936
Supplies..........	$37	78	128	200
Plant charges..........	$438	657	936	1,426
Fuel and water..........	$357	658	987	1,629
Total costs per year..........	1,222	1,978	2,831	4,191
H. P. hour per year..........	5,544	13,860	27,720	55,440
Costs per H. P. hour, cents..........	22.05	14.28	10.22	7.56

We have now covered the cost of power generated by steam engines, and will, without comment, pass to the cost of electric power, having finished which, we will be in a position to more intelligently compare the advantages offered by either method on the score of cost alone. The load factors, and the actual brake horse-power delivered by the electric plant will, of course, be precisely the same as for the steam plant.

REDUCTION IN COST OF STEAM POWER FROM 1870 TO 1897.[1]—II.

By F. W. DEAN.

(Concluded.)

THE economies thus far mentioned relate to improvements in engines and boilers; but one of the greatest economies results from the low cost of coal at present in Lowell, Lawrence, and similarly located towns.

The prices of coal in these places every five years were as follows:

Year.	Price.	Kind of Coal.
1870..........	$7.10..........	Anthracite.
1875..........	7.20..........	"
1880..........	4.75..........	Bituminous.
1885..........	4.25..........	"
1890..........	4.65..........	"
1895..........	3.85..........	"

These prices show a saving from 1870 to 1895 by themselves of about 46 per cent.

I shall now consider the actual figures making up the cost of a mill steam plant, and its cost of operating, say, of 1,000 h. p. in most mill towns in the State of Massachusetts away from tide-water.

The very best steam plant of this power twenty-seven years ago, including a pair of simple condensing engines using 20 pounds of steam, boilers evaporating 8 pounds of water on total coal used, buildings, chimney and all accessories, cost $70 an indicated horse-power.

The fixed charges on such a plant were interest at 6 per cent., depreciation at 4 per cent., repairs at 2 per cent., insurance at 1 per cent., or a total of 13 per cent.

[1]Presented at the New York meeting (December, 1897) of the Am. Soc. Mech. Engrs. Abstract.

13 per cent. of $70 is	$9.10
Coal at 2.50 lbs. per I. H. P. per hour, at $7.10 a ton, $\frac{2.50\text{ lbs.}\times10\text{ hrs.}\times308\text{ days}\times\$7.10}{2,240}=$	24.40
Attendance, boilers $\left\{\begin{array}{l}\text{3 day men at \$1.50}\\ \text{1 night man at \$1.50}\end{array}\right\}\frac{\$6\times308}{1,000}=$	1.85
Attendance, engine $\left\{\begin{array}{l}\text{1 engineer at \$3.00}\\ \text{1 assistant at \$2.00}\end{array}\right\}\frac{\$5\times308}{1,000}=$	1.54
Oil, waste and supplies	1.25
	$38.14

The very best plant of 1,000 h. p. can be installed to-day complete, including buildings, chimney, compound engine using 12.5 pounds of steam, boilers evaporating 9 pounds of water on total coal used, economizers, and all accessories, for $57 per indicated horse-power.

Such a plant can run on 1.4 pounds of coal per indicated horse-power per hour for total coal consumed.

The fixed charges are interest at 5 per cent., average depreciation 3½ per cent., repairs 2 per cent., insurance and taxes 1 per cent., or a total of 11½ per cent.

11½ per cent. of $57 is	$6.55
Coal at 1.4 lbs. per I.H.P. per hour, at $3.85 a ton, $\frac{1.4\times10\times308\times\$3.85}{2,240}=$	7.41
Attendance, boilers $\left\{\begin{array}{l}\text{2 day men at \$1.50}\\ \text{1 night man at \$1.50}\end{array}\right\}\frac{\$4.50\times308}{1,000}=$	1.39
Attendance, engine $\left\{\begin{array}{l}\text{1 engineer at \$3.50}\\ \text{1 assistant at \$2.00}\end{array}\right\}\frac{\$5.50\times308}{1,000}=$	1.69
Oil, waste and supplies	.80
	$17.84

Saving in 27 years in first cost, $\frac{\$70-\$57}{70}=$ 18.6 per cent.

Saving in 27 years in operation, $\frac{\$38.14-\$17.84}{38.14}=$ 53 per cent.

On the supposition that superheated steam can reduce the steam consumption to 10 pounds per indicated horse-power per hour, and that the combined efficiency of boilers and economizers is not affected thereby, the cost of installation of 1 h. p. can still be taken at $57.

The cost of coal per I. H. P. will be:

$\frac{\text{1.11 lbs. x 10 hrs. x 308 ds. x \$3.85}}{2,240}=$	$5.88
Other charges will be	10.43
Total	$16.31

This makes a saving of yearly charges, compared with the best present plant, of $\frac{\$17.84-\$16.31}{\$17.84}=$ 8½ per cent.

Some actual costs of a yarn mill in Massachusetts built in 1889 are as follows:

Cost per horse-power of engine (compound)	$60.50
Total coal burnt per year	2,674 tons
Average I. H. P. for the year	1,132 I. H. P.
Total coal burnt for power, heating mill, and banking fires, per I. H. P. per hour	1.75 lbs.
During the six months when no heating was done, the coal used per I. H. P. per hour was	1.65 lbs.

The cost of operating a horse-power per year was as follows, assuming 11½ per cent. fixed charges:

Total cost of plant, $66,600, at 11½ per cent.	$7,659.00
Coal, 2,674 tons, at $4.75 per ton	12,701.00
Attendance $8.85 a day x 308 days	2,725.80
Oil, waste and supplies	312.00
Total cost of power	$23,397.80

Average horse power per year	1,132 I. H. P.
Cost per I. H. P. per year	$20.67
Cost corrected for coal used in heating mill	20.01

In order to place them in the pages of the Transactions of the society, and as illustrating a recent steam engine performance, I add the results of two trials of a high class steam engine built within the last year. Considering the steam pressure used, it is the best performance of which I know. The engine is at the mills of the Atlantic Cotton Mills, Lawrence, Mass., and the trials were made on February 17 and 18, 1897, by the writer. The engine was built by the McIntosh & Seymour Engine Company, of Auburn, N. Y., and is a vertical cross-compound, having its shaft a part of the water-wheel shaft. It is provided with gridiron inlet and exhaust valves on both cylinders, and auxiliary cut-off valves of the same kind on both cylinders. The valves have positive motions throughout, and the points of cut-off are determined on both cylinders by a shaft governor.

The high pressure cylinder is jacketed throughout by steam of boiler pressure, and there are reheating coils in the receiver, through which live steam of boiler pressure circulates. The low pressure cylinder is unjacketed. During both tests the condensations from the jacket and reheater were weighed together on platform scales, the amounts of which are stated below. The temperature of the condensation was determined some 30 feet from the reheater. The boilers supplied steam to nothing but the engine.

A feed water heater was placed in the low pressure exhaust pipe near the low pressure cylinder, and the temperatures of the water, as it entered and left, were taken for the purpose of the information gained thereby, although it had no relation to the contract for the engine. For the same reason the jacket and reheater condensations were determined.

The following are the leading dimensions of the engine, and the result:

Dimensions of McIntosh & Seymour Engine.

Diameter of the high pressure cylinder, in.	24.031
Diameter of the low pressure cylinder, in.	48.031
Diameter of the high pressure piston rod, in.	5.00
Diameter of the low pressure piston rod, in.	5.00
Ratio of piston areas	4 to 1
Stroke of each piston, in.	48.00
Revolutions per minute, revs.	about 100
Piston speed per minute, feet	about 800

Results of Trials.

	1st Trial.	2d Trial.
1. Duration, hrs.	5.079	5.583
2. No. of revs. per minute, revs.	100.704	99.633
Superheat.		
21. Superheat near high pressure cylinder, degs.	7.5	29
22. Superheat near low pressure cylinder, degs.	74	61
Powers.		
23. Power developed by high pressure cylinder, h. p.	365.2	470.6
24. Power developed by low pressure cylinder, h. p.	492.9	605.8
25. Total horse power	858.1	1,076.4
26. Per cent. of power developed by high pressure cylinder	42.5	43.7
27. Per cent. of power developed by low pressure cylinder	57.5	56.3
Steam Used by the Engine.		
28. Total weight used by engine, jacket, and reheater, lbs.	56,271	76,662
29. Total weight used by engine, jacket, and reheater, per hour, lbs.	11,167	13,731
30. Total weight used by jacket and reheater, lbs.	5,881	7,475
31. Total weight used by jacket and reheater, per hour, lbs.	1,158	1,339
32. Per cent. of jacket and reheater steam to total used	10.4	9.8
33. Actual weight of total steam used per I. H. P., per hour, lbs.	13.01	12.76
34. Do. corrected for superheat, lbs.	13.05	12.87

The results on the two days furnish some interesting data in relation to the falling off in economy of a compound engine when it is underloaded. Taking the results of the second test as a standard, the load on the first day is 20 per cent. less, while the steam consumption is but slightly over 1 per cent. more.

The average increase in feed water temperature caused by the heater, for the two days is 65½ degs., which, under the present conditions of temperature and steam pressure, is equivalent to a saving in coal of 5.6 per cent.

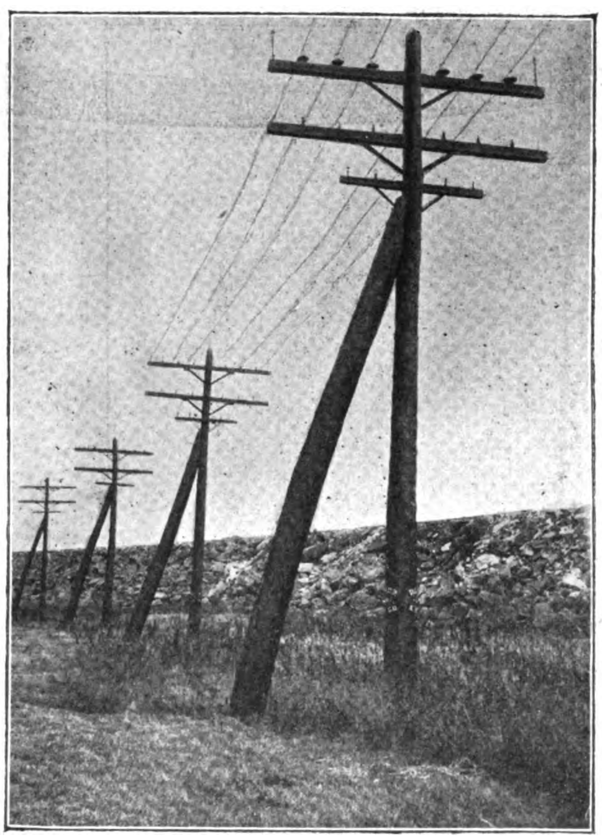
PLAINFIELD, N. J.—The citizens of Union County have resolved to take the bit in their teeth and give the experiment of "municipal ownership" a practical test. The plan is to construct a trolley railroad from Elizabeth to Plainfield, taking in six towns en route, the whole to be built and run by the county.

VENTILATORS AND EXHAUSTERS FREE OF DUTY IN THE NETHERLANDS.

Minister Newel reports to the State Department from The Hague, under date of October 22, 1897, that, by ministerial order of October 11, 1897, it has been ordered that ventilators, exhausters, and bellows which are worked by a steam, gas, petroleum, or electric motor only, and are used in factories and on ships, and only in exceptional cases elsewhere, may henceforth, and for that reason, be admitted free of import duty. Ventilators for ordinary ventilating purposes and not worked by the aforementioned motive power shall remain subject to the existing duty.

NIAGARA-BUFFALO TRANSMISSION LINE.

THE great power transmission line connecting Buffalo with Niagara Falls has been doubled in its capacity, and now six instead of three cables stretch on the cross arms of the magnificent pole line. These line conductors are identical with those first strung, being each of 350.000 c. m. The cables first strung, in 1896, were placed on the upper cross arm, and the new cables are on the same cross arm, taking the opposite side. The insulators used are made by the Imperial Porcelain Works. The cable is the product of the American Electrical Works. At the Niagara end of the line, in the transformer station of the Niagara Falls Power Company, additional transformers are being installed in order to raise the voltage of the current generated for transmission over the new section of the line. In all there is now about 156 miles of cable on the line, with good prospects of its soon being further increased, as many Buffalo industries find it very much to their advantage to use the sure, always-ready power developed by the Niagara Falls Power Company. The construction was done by the J. G. White Company.

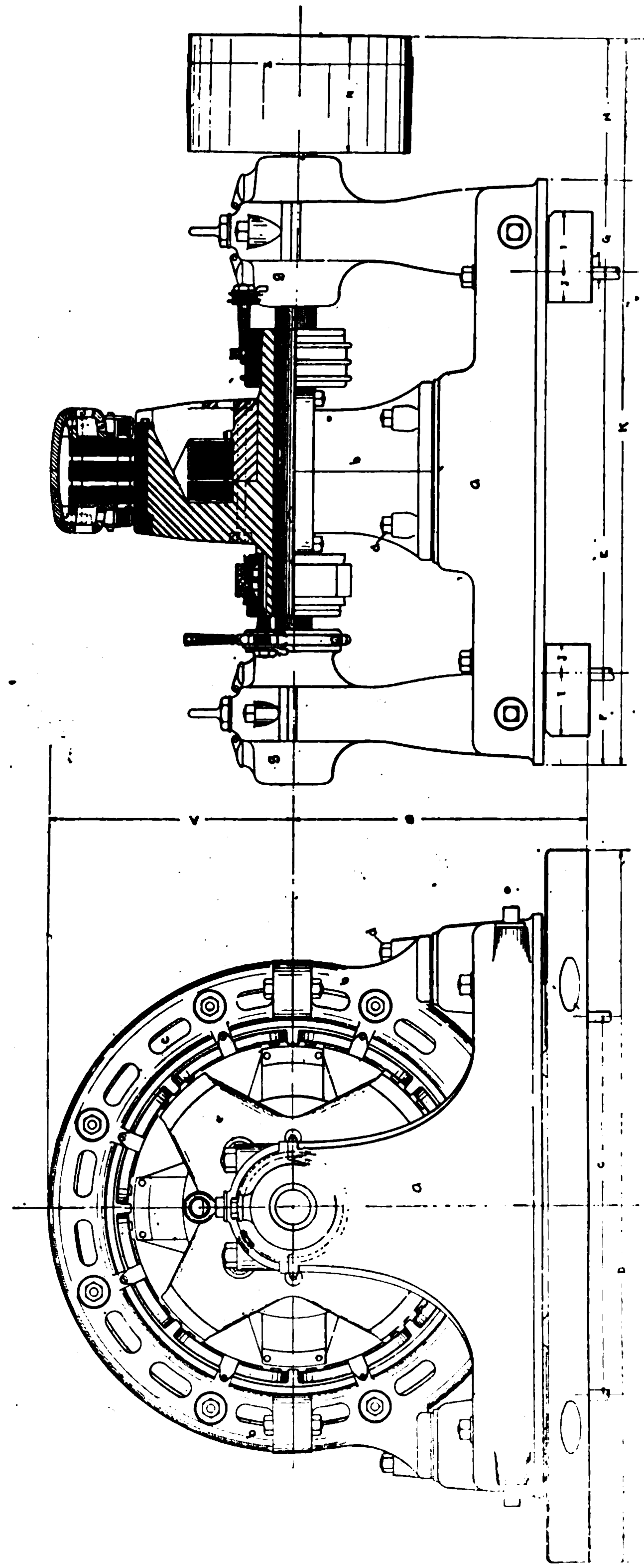


THE NIAGARA-BUFFALO POWER TRANSMISSION LINE, DECEMBER, 1897.

THE NEW WALKER ALTERNATORS.

FOR some time past, the engineers of the Walker Company have been engaged in designing a line of alternating machines, which embody a number of novel features.

The inductor type of machine has been adopted, with a stationary armature, which can be wound and insulated for any required pressure. This, in the case of power transmission, avoids the necessity, in most cases, for using a step-up transformer. The inductor, which is the only revolving part of the machine, is excited by a field coil, which, in the case of lighting machines, is compound wound, so that the pressure may rise in direct proportion to the increase in the load. The machines are separately excited by a small direct current



FIGS. 1 AND 2.—NEW WALKER INDUCTOR ALTERNATOR.

dynamo, which is furnished with each generator. The company have adopted 60 cycles per second as its standard for machines to be used for lighting, and for plants where both lighting and power are furnished. For long distance power transmission, however, 30 cycles are used. The generators are wound for single, two, or three-phase current, as the exigencies of the work may demand.

Figs. 1 and 2 illustrate the standard belted type alternator, having a sub-base a, upon which is mounted the stationary

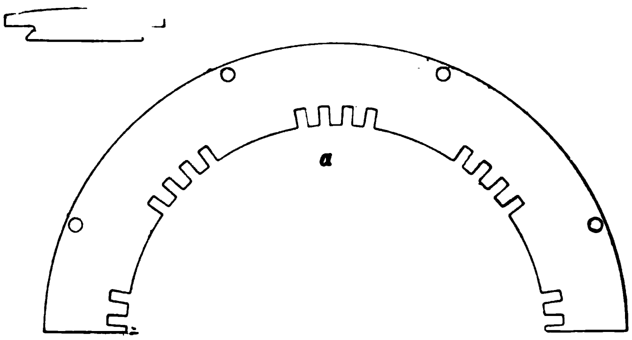


Fig. 3.—Armature Punching of New Walker Inductor Alternator.

armature ring frame b. This frame is divided into halves on a horizontal plane, so that the upper half can be removed to inspect and repair the armature bobbins or to remove the inductors.

The armature core, which is made with inwardly projecting teeth, is constructed of the best quality of laminated steel and is held firmly in the armature ring frame. The armature coils, which are rectangular in shape, and machine wound, are arranged around its inner surface and thoroughly imbedded in slots formed on the inner periphery. The armature core is ventilated by means of air ducts passing radially through its mass, as in the revolving armature of the direct current machine. The armature frame is hollow, with large openings to the atmosphere, as shown at c, permitting the air freely to circulate through the armature air ducts and around the core iron and armature coils. These ducts, combined with the fanning effect of the rapidly moving arms on the revolving inductor, form a most perfect system of ventilation. The entire armature with its frame can be moved parallel with the axis of the shaft by removing the bolts d, which fasten it to the sub-base, thus uncovering the armature coils for inspection or repair, without the necessity of removing the upper half of the armature.

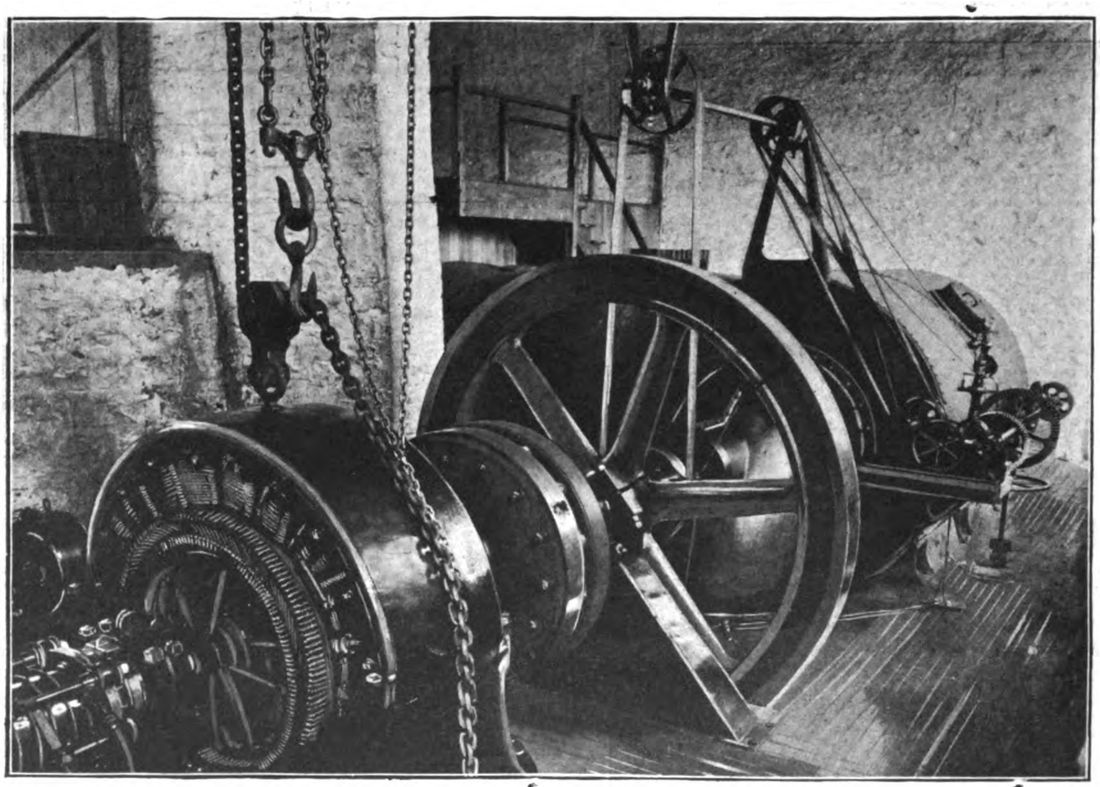
The inductor e is carried by the shaft f, which is made to rotate in the bearings g. This inductor consists of a hub made of steel, with radiating arms or spokes at either end, which spokes alternate in spacing and have their outer ends bent into line over the center of the hub, leaving an annular space around the hub, where the single field magnet spool is carried, wound with the shaft as its axis. The ends of the inductor spokes are tipped with blocks of thin laminated steel to avoid heating them by the formation of eddy currents. Two extensions of the hub are provided, one outside of the inductor arms at either end. Upon one extension is carried a pair of collector rings h, which carry the current from the exciter to the field magnet coil, which rotates with the inductor.

When the alternator is to be over-compounded for incandescent lighting, the commutator i is placed on the other extension of the inductor hub, having in its periphery as many bars as there are spokes on the inductor. The alternate bars are connected together and then to the ends of the series winding of the field magnet. A portion of the armature current is thereby rectified and as its quantity increases the magnetization of the inductor increases, producing the requisite over-compounding. Carbon brushes are used on both the collector rings and commutator in all cases.

In Fig. 3 a illustrates one of the armature laminations, showing the internal slotting for single-phase. For two-phase winding the unslotted portion would be punched out, making the teeth uniform in width throughout. One of the punchings used in building up the inductor arm tips is shown in Fig. 3.

The armature coil, which is rectangular in shape, is wound on a form in a lathe and then thoroughly saturated with armature varnish and baked. After baking it is completely incased in a combination of mica and paper insulation, and finally taped with oiled linen. These coils will easily stand 10,000 volts constant pressure.

The Walker Company also build a large direct coupled alternator, intended for power transmission, on the same general lines as the machine described above. It runs at 80 revolutions per minute, has 48 inductor arms, and has a capacity of 800 k. w. at 30 cycles per second.



McCool Tube Works Power Plant, with Westinghouse Generator and McCormick Turbines.

A NOVEL POWER PLANT AT BEAVER FALLS, PA.

We present herewith an illustration which represents a pair of 33 inch McCormick turbines of 250 h. p. and 150 revolutions direct connected to a Westinghouse generator in the station of the McCool Tube Works, Beaver Falls, Pa. The turbines are mounted on horizontal shafts, each dis-

charging into a separate draft tube. The speed is regulated by means of a Moore electric governor. The power is used by the McCool Tube Works, for operating their new machine shop located a short distance from the power plant. This outfit has been in successful operation for about a year. The generator is of 200 k. w. capacity and distributes current to no fewer than 20 motors, running up to 15 h. p. in their respective capacity. A novel feature of the plant is that as the power-house is liable to be flooded in unusually wet seasons, special provision has been made for hauling the dynamo right up out of the reach of the water, so as to prevent it from receiving injury.

SOCIETY & CLUB NOTES

MEETING OF THE UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION ELECTRICAL COMMITTEE.

A PRELIMINARY meeting of the Electrical Committee of the Underwriters' National Electrical Association was held at the National Board rooms, 156 Broadway, December 6, at 2:15 p. m. There were present: F. E. Cabot, chairman; C. M. Goddard, secretary; W. H. Merrill, W. A. Anderson, E. V. French, W. McDevitt, J. C. Forsythe, E. A. Fitzgerald, A. M. Schoen and A. E. Braddell of the committee, and also F. C. Moore, chairman of the Electrical Committee of the New York Board; J. T. Ryan, chairman of the Electrical Committee of the Underwriters' Association of New York State; E. C. North, chairman Electrical Committee; Ralph Sweetland, electrician of the New England Insurance Exchange.

The secretary read a letter from E. U. Crosby, secretary of the National Fire Protective Association, asking for the appointment of a committee of conference on the subject of thermo-electric fire alarm rules and regulations.

On motion of Mr. Anderson, it was voted that the chair appoint a committee of three in accordance with this request. The chair appointed W. H. Merrill, W. McDevitt and Ralph Sweetland.

The secretary reported the adoption of the National Electrical Code by the various boards of underwriters and also by the different associations represented in the National Conference.

Mr. Merrill moved that the committee urge city inspection departments to adopt the national electrical code as a part of their ordinances.

Resolutions on this subject were offered as an amendment, and after further amendment, were adopted as follows:

"Whereas, A number of municipalities have, during the past year, adopted ordinances including the national electrical code as standard specifications for safe wiring to secure the protection of lives and prevention of fires from the electrical hazard; and

"Whereas, The electrical inspection departments created under these ordinances have aided in securing superior electrical construction, therefore be it

"Resolved, That the Electrical Committee of this Association ask the Executive Committee of the National Board of Fire Underwriters to consider the advisability of encouraging the establishment of municipal electrical departments in the various cities and towns throughout the country for the regulation and control of the electrical hazard."

Mr. Merrill moved that it was the sense of the meeting from the secretary's report of favorable action upon the National Electrical Code in its present state, that the discussions at the meeting on Tuesday be restricted as far as possible to class "D" of the code; it being evident that the subject of the motion met with favorable consideration, but that there was some objection to its formal adoption the mover withdrew the same.

The question of publication of a list of approved fittings and devices was fully discussed, and it was evidently the sense ofthe committee that such a list should be published after having been approved in the whole by the various insurance inspection departments.

On motion it was voted to adjourn until 10 a. m. Tuesday, December 7, at the rooms of the New York Board of Fire Underwriters.

The fifth annual meeting of the Electrical Committee of the Underwriters' National Electrical Association was held at the rooms of the New York Board of Fire Underwriters at 10:30 a. m. There were present of the Electrical Committee: F. E. Cabot, chairman; C. M. Goddard, secretary; W. H. Merrill, Jr., A. E. Braddell, W. A. Anderson, E. V. French, W. McDevitt, E. A. Fitzgerald, A. M. Schoen and J. C. Forsythe. There were also present: Prof. F. B. Crocker, president of the American Institute of Electrical Engineers; W. J. Hammer, president of the National Conference on Standard Electrical Rules; Alfred Stone, secretary of the American Institute of Architects; H. C. Wirt, of the American Institute of Electrical Engineers; Thos. Sturgis, commissioner; Alex. Henderson, chief inspector; J. E. Smith, superintendent of telegraph of the Fire Department of New York City; F. C. Moore, chairman of the Electrical Committee New York Board of Fire Underwriters; J. T. Ryan, chairman Electric Light Committee Underwriters' Association of New York City; Wm. S. Wensley, secretary Middle States' Inspection Bureau; F. M. Griswold, general inspector Home Insurance Company; H. F. Blackwell, Jr., Brooklyn Fire Department; E. M. Davis, superintendent of wires, Brookline, Mass.; J. E. Cole, Wire Department, Boston; H. A. Knight, supervisor of wires, Worcester, Mass., and the following insurance electrical inspectors: F. J. Fetter, Kansas City Board of Fire Underwriters; J. U. Burket, Association Fire Underwriters of Washington; Wm. M. Venable, Cincinnati Underwriters' Association; M. B. Matthews, New York Board of Fire Underwriters; H. C. DeCamp and A. Anthon, Suburban Underwriters' Association; Ralph Sweetland and J. Couilliard, New England Insurance Exchange; W. T. Benallack, Michigan Inspection Bureau; Frank Kitton, Buffalo Association of Fire Underwriters'; Geo. B. Lauder, New Hampshire Board of Underwriters; G. W. Wilson, Boston Fire Underwriters' Union; H. C. Cushing, Jr., New York Tariff Association; H. O. Lacount and Prof. Wm. L. Puffer, Factory Mutual Fire Insurance Companies; M. E. Eden and R. C. Eden, Underwriters' Association of the Middle Department; C. R. Reynolds, Hartford Board of Fire Underwriters; and W. B. Lewis, Insurance Associations of Providence.

On motion, the courtesy and freedom of the floor were extended to all present, as it has always been the custom at the annual meetings of the committee not to confine the privilege of discussion and voting to the members of the committee.

It was decided to take up the question of specifications for approved fittings and devices in order that the electrical bureau of the National Board of Fire Underwriters might establish such specifications and requirements more in detail than now provided for in the National Electrical Code.

The details for construction of knife switches, as contained in bureau report No. 738, were thoroughly discussed, and with a few changes adopted as printed, with the exception of the last section relating to break distances, which was referred to a committee of five, consisting of Messrs. French, Crocker, Merrill, Goddard and Forsythe for a report at the morning session on Wednesday.

The specifications for wire tests were considered and it was voted to make the break down test of 5 minutes duration and to refer this matter to the American Institute of Electrical Engineers with the request that they express an opinion to the propriety of this time limit.

It was also voted that the bureau for a year make the insulation test on wires with a limit of 100, instead of one megohm per mile, and report the results of these tests at the next annual meeting.

The subject of cut-out blocks and fuses for use on the circuits of various potentials and capacity was very thoroughly discussed, and while no definite conclusions were reached, a great deal of valuable information and many suggestions were presented which it is hoped will assist the bureau in its work on this most important and difficult subject.

The committee then adjourned until 9:30 Wednesday morning.

The second day's meeting of the Electrical Committee was called to order by the chairman at 10:30 a. m.

Mr. French for the Committee on Break Distances for Knife Switches reported a table of such distances for switches up to 300 volts, and also a table for switches from 300 to 600 volts, and on motion the report of the committee was adopted.

The question of publishing and distributing a list of approved devices by the bureau at Chicago was very thoroughly discussed, and it was voted that such a list be published quarterly. The first list to be submitted to all the inspection departments before publication, and all changes in such list to be submitted before being made, and that after the publication of the first list the table of approved materials be omitted from the Code of Rules.

It being the sense of the meeting that some action should be taken in regulating the installations of kinetoscopes and similar devices, it was voted that the subject be referred to a committee of three, consisting of Messrs. FitzGerald, Schoen and Lewis.

It being suggested that improvements could be made in the construction of the various sockets now on the market, it was

voted to refer the general subject of the construction of sockets to a committee of three, consisting of Messrs. French, Sweetland and Lauder, for the purpose of drawing up specifications with which approved sockets should comply.

A committee of three, consisting of Messrs. Forsythe, DeCamp and Braddell, was appointed to draw up specifications and requirements for testing flexible cord.

On motion of Mr. Ryan, of the New York State Association, it was voted that it was the sense of the meeting that a meeting of the full association should be provided for previous to the next meeting of the Electrical Committee, as no such meeting has been held for some three years.

Chairman Moore, of the Electric Light Committee of the New York Board of Fire Underwriters, called attention to the fact that the fire department of New York City were preparing to issue a code of rules which differed very materially, especially in their arrangement and phraseology, from the National Code, and urged the necessity of using every effort to secure uniformity of rules between the underwriters' and the municipal departments, and after remarks by Mr. Alex. Henderson, the electrician of the New York Fire Department, it was voted that a committee of five be appointed to confer with the New York Fire Department on this subject, for the purpose of obtaining such action as would secure the greatest possible uniformity which circumstances would permit. The chair appointed Messrs. Anderson, Merrill, DeCamp, FitzGerald and Goddard, as this committee, and a conference was held with the New York Fire Department representatives on Friday, December 10.

In order that greater security might be obtained against the hazard of transformer breakdowns, a committee of five, consisting of Messrs. Lewis, Schoen, McDevitt, Puffer and Merrill were appointed for the purpose of investigating and reporting on the steps which seemed desirable to attain this end.

At the suggestion of Mr. Schoen, a committee, consisting of Messrs. Schoen, FitzGerald and M. E. Eden, was appointed to report suggestions for rules to govern the installation of telephone, telegraph and similar wires.

After extending a vote of thanks to the New York Board of Fire Underwriters for the use of their rooms for meetings of the committee, the meeting adjourned.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

A monthly meeting of the Institute was held in this city on December 16, when Mr. Thorburn Reid presented a valuable paper on "Sparking" in dynamo electric apparatus, and its remedies. Several members participated in the discussion, notably Mr. Gano S. Dunn. The evening closed with an interesting exhibition of the Marconi or wireless telegraphy by Mr. W. J. Clarke, who placed the radiator at one end of the long rooms and the coherer, with tapper, etc., at the other end, a distance of 70 or 80 feet. Signals were sent through the closed sliding doors between the two rooms. Over 100 members and friends witnessed the experiments.

NORTHWESTERN ELECTRICAL ASSOCIATION.

The sixth annual convention of the Association will be held at Milwaukee, beginning January 19. A full meeting with some excellent papers is expected.

THE ELECTRICAL WORKERS in convention at Detroit agreed to prohibit its members from enlisting in the militia. The resolution was very strenuously opposed.

NEWS AND NOTES

ELECTRIC LIGHT WIRE TAPPING AT TERRE HAUTE, IND.

A special dispatch from Terre Haute, Ind., says: Grant Kress and George Musgrave have been arrested for tapping the wires of the Citizens' Electric Light Company. They called on Madge Henderson, the keeper of an illegal house, and made a proposition to light her house with electricity, offering to make the necessary connections for $2. After the wires were connected the woman gave them $1 and promised to pay the other dollar soon. Kress and Musgrave were unable to collect the dollar and sought to revenge themselves by secretly disconnecting the wires. This was a fatal move, for the woman sought the cause at the company's office, and both men were jailed. They admit their guilt.

PERSONAL

THE ALEXANDER TRIUMVIRATE.

Mr. Hugo Alexander.

It is interesting to note the progress of engineering in its different branches, especially when applied to practical use in everyday life. The business of the Alexander-Chamberlain Electric Company, No. 56 West Twenty-second street, New York, is one of the best illustrations of this and the many uses to which both electrical and mechanical appliances are put.

Although the Alexander-Chamberlain Co. is not quite six years old, and managed by young and aggressive officers, it has succeeded each year in securing its full share of an increasing and very desirable business. Some of their work is not only very prominent, but also of such magnitude that The Engineer has through its columns had frequent occasion to call its readers' attention to it.

Recent increase in the business of the company has finally compelled a call for the active assistance of their president, Mr. Hugo Alexander, who, until December 1 was only identified with it in a passive way. This gentleman, who has now assumed an active interest, is a man of sound business principles and very popular with all whom he has come in contact during fifteen years of a mercantile career. He has watched over the Alexander-Chamberlain Electric Co. with a sort of fatherly interest and was one of the original incorporators. Mr. Hugo Alexander will represent the company on the outside, where all those who know him will wish him success.

Mr. Adolph Alexander.

Mr. Adolph Alexander, secretary and treasurer of the company, has been actively identified with it for five years, and he has had the pleasure of seeing the company grow rapidly into prominence, a good share of which is due to his careful, shrewd and constant attention to his duties. He is the eldest of the three graces, who will figure from now on even more prominently in the fraternity than heretofore.

Mr. Harry Alexander, vice-president and general manager of the company, on whose experience the company bases its claims to technical superiority, is the youngest of the triumvirate, and has been responsible for the work of the Alexander-Chamberlain Electric Company in the past in the electrical engineering field. He needs no further introduction to the electrical fraternity, as his works speak for themselves. Among a list of nearly a hundred plants installed by the company in office buildings, banks, stores, factories, mills, hotels, breweries, residences, clubs and steamships, we may mention the great Siegel-Cooper store, Stern Bros., Mail and Express Building, Hotel Minot, Atlantic Yacht Club, Progress Club, Ss. Algonquin, Ss. El Norte, etc.

Mr. Harry Alexander.

MR. C. C. HASKINS has, we are glad to note, been requested to resume duty in the City Electrical Department, of Chicago, and is now pursuing his old duties as electric light inspector.

MR. BANKER R. PAINE, representing the Canadian Power Company, of Niagara, Ont., was in town asking for quotations

and data on the electrical transmission of power from Niagara to Toronto, a project which he reports as now under serious consideration.

PROF. F. B. CROCKER, of Columbia University, and president of the American Institute of Electrical Engineers, left immediately after the Institute meeting on Wednesday evening last for a round trip to Jamaica, West Indies, being run down from work and in need of a brief respite. He will be back around the New Year.

EDUCATIONAL

ELECTRICAL ENGINEERING TAUGHT BY MAIL.

JUDGING from the results of many years experience, it is safe to say that there is no system of instruction as well suited to the wants of mechanics, engineers, attendants, superintendents, salesmen, wiremen, motormen, men who install electrical machinery and others who have not had the means nor the time to attend a college, as correspondence instruction. This system of instruction has been gradually developed and improved by the management of the United Correspondence Schools of New York and has stood the test of many years. Their courses in electrical, mechanical, steam, civil and sanitary engineering, in art and architecture and the trades are complete and thorough and not a single enrolled student has ever failed to successfully complete his course and reap benefits therefrom.

Instead of burdening the student with expensive textbooks, frequently difficult to understand, competent and practical instructors are employed to prepare instruction and question papers, carefully graded, free from all superfluous matter, simple, accurate and thoroughly up to date, yet complete and well illustrated.

These are sent to the student and are studied and answered by him in his leisure moments. Experienced instructors criticize the work he returns to them, and in this way every student has the advantage of individual instruction. Each student by this method is instructed according to his individual requirements. He can advance as rapidly as his efforts permit, and is not held back by any who are less diligent than himself. The instruction is confidential, and a student can begin at any time, the requirements for admission being a knowledge of reading and writing. The fees charged are very moderate, and can be paid either in advance or in installments in amounts to suit the convenience of the student.

The faculty of teachers is under the competent direction of Mr. F. W. Ewald, who has had a very extensive experience in teaching by correspondence.

Catalogues, terms, sample instruction and question pages and drawing plates will be sent to any one upon application to the United Correspondence Schools, 154, 156, 158 Fifth avenue, New York.

THE STOCK MARKET

SATISFACTORY REPORTS.

One of the noteworthy features of the current week has been the enormous demand for and production of pig iron and steel, the former at slightly lower prices and the latter at prices that are stronger and higher. Bank clearings compare more than favorably with the big figures of 1892, while business failures are smaller again than the average. The stock market has been reacting on dearer money due to the heavy operations in the purchase of the Union Pacific road from the Government, and bonds and stocks have been somewhat less in demand, although prices stiffened toward the end of the week. Of Western Union, 15,840 shares were sold around 90⅛; General Electric, 4,105 from 33¼ up to 34; and American Bell Telephone up to 264.

Copper is quoted at 11 cents. Heavy steel rail is $19 per ton.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED DECEMBER 7, 1897.

Alarms and Signals:—

ELECTRIC ALARM DEVICE. L. Fitzgerald, Hartford, Conn., and J. Fay, Yalesville, Conn., 595,096. Filed Feb. 12, 1897. A fire alarm circuit adapted to be closed by the mercury in a thermometer when it reaches a predetermined point.

AUTOMATIC RECORDER FOR ELECTRICALLY OPERATED RAILWAY GATES AND SIGNALS. J. M. Williams, Danville, Va., 595,243. Filed July 28, 1897. Adapted to be operated by a vehicle, horse or person, and to make a record either with the gate full open or when closing to place responsibility in case of accident.

Batteries, Primary:—

ELECTRIC BATTERY. W. M. Storm, New York, 594,917. Filed Dec. 8, 1896. Comprises an absorbent layer provided with a number of small glass tubes for preventing the compressing of the material.

Batteries, Secondary:—

SECONDARY BATTERY. R. Ashley, Port Republic, N. J., 595,132. Filed Oct. 9, 1896. A positive electrode for storage batteries consisting of a number of thin plates having their ends bent over upon the main portion and superimposed upon and secured to each other and the surfaces of the plates formed with a large number of small interstices.

STORAGE BATTERY. J. D. Rively, Pittsburg, Pa., 595,208. Filed Feb. 19, 1897. A series of electrodes arranged horizontally within a casing, a vertically arranged insulating plate dividing the series into cells, a metallic perforated feed pipe connecting the cells and suitable connections.

Conductors, Conduits and Insulators:—

ELECTRIC CABLE. J. H. Kelman, Pittsfield, Mass., 594,882. Filed Sept. 25, 1897. Consists of several conductors, each separately coated with varnish hardened by oxidation, and a covering holding the conductors together in close proximity.

TERMINAL FOR ELECTRIC CONDUCTORS. W. P. Booth, South Bend, Ind., 594,932. Filed Dec. 16, 1896. A plug having multiple conducting contacts mounted on one side of a body of insulating material and adapted to be inserted between resilient conducting strips and electrodes.

CONDUIT FOR ELECTRIC WIRES. R. W. Lyle, Perth Amboy, N. J., 594,996. Filed Oct. 1, 1897. A conduit having longitudinal and transverse scorings in its body to facilitate the removal of its sections.

ARMORED CONDUIT. E. T. Greenfield, New York, 595,238. Filed July 27, 1897. Consists of a flexible interior insulating tube and one or more spirally wound layers of metal secured thereto.

Dynamos and Motors:—

ARMATURE FOR DYNAMO ELECTRIC MACHINES. S. H. Short, Cleveland, O., 595,081. Filed March 12, 1897. A separating lamina for a dynamo electric armature, having peripheral teeth, the ends of which are bent at right angles.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. H. M. Baker, Jr., and A. W. Fox, Brooklyn, N. Y., 594,928. Filed Feb. 24, 1897. Feed mechanism.

SUPPORTING MEANS OR BRACKET FOR LAMPS. R. W. Pitman, Hartford, Conn., 595,074. Filed Sept. 21, 1896. Comprises a telescopic weight supporting device, a laterally sliding counterbalance supported thereby, and a telescopic lamp carrying device.

Miscellaneous:—

ELECTRIC SOLDERING IRON. F. H. Harriman, Hartford, Conn., 594,872. Filed April 17, 1897. Embodies a soldering head constituting one terminal of an electric circuit; a conducting shell surrounding and insulated from its stem and filled with a comminuted carbonaceous material and constituting the other terminal of the circuit.

TROLLEY CONNECTION FOR CANAL-BOATS. F. J. Shewring, Toronto, Can., 594,913. Filed March 11, 1897. Provides the boat with a rigid trolley pole, a gravity balanced trolley wheel on the wire and connected to the trolley pole with a wire of sufficient slackness to permit of freedom in the movements of the vessel.

ELECTRICAL IGNITER FOR GAS ENGINES. B. W. Grist and E. Cellison, Philadelphia, Pa., 595,016. Filed August 21, 1896. Details of construction.

CLOTH CUTTING MACHINE. G. Swope, Chicago, Ill., 595,084. Filed Feb. 27, 1897. Details of construction.

Railways and Appliances:—

CONTROLLER FOR MOTORS AND BRAKES OF ELECTRIC CARS. A. Grossman, New Orleans, La., 594,946. Filed August 31, 1897. Comprises a rotary brake-staff, a rotary rheostat, a wheel loose on the brake-staff and connected by gearing with the rheostat shaft, a handle for turning the brake-staff and means for detachably fixing the handle to the loose wheel.

ELECTRIC RAILWAY. G. Westinghouse, Pittsburg, Pa., and W. Chapmann, Washington, D. C., 595,008. Filed Oct. 31, 1896. A contact rail formed of angle iron, with insulating supporting blocks and longitudinally extending rods, one for each block, provided with laterally extending clamping devices, whereby the rail is held against lateral movement.

TROLLEY ARM FOR ELECTRIC RAILWAYS. S. H. Short, Cleveland, Ohio, 595,080. Filed Sept. 26, 1896. A trolley arm, and two fork arms with a Y-shaped connection uniting the arm and fork arms, and a roller mounted in the upper ends of the fork arms.

THIRD RAIL INSULATOR. A. Anderson, Boston, Mass., 595,089. Filed July 23, 1897. An insulating support comprising a metallic hood provided with longitudinal sockets on its inner side, a metal bolt having its head and shank covered with insulating material, longitudinal ribs on the insulated head engaging the longitudinal sockets in the hood, and a base to which the bolt is secured.

UNDERGROUND TROLLEY SYSTEM. L. E. Watkins, Springfield, Mass., 595,224. Filed May 17, 1897. Embodies a conduit having three insulated longitudinal compartments. Details of construction.

Regulation:—

ELECTRIC ELEVATOR CONTROLLER. C. M. Weymann, San Francisco, Cal., 595,086. Filed Jan. 27, 1897. Details of construction.

Switches, Cut-Outs, Etc.:—

POTENTIAL SWITCH. J. H. Ihlder, Yonkers, N. Y., 594,879. Filed Oct. 15, 1896. Comprises two sets of terminals, a cup-shaped housing, inclosing the magnet, an armature thereon having a lug, a lever mounted on the housing, and having a catch engaging the lug on the armature, the lever being under stress of a spring.

FUSE PLUG. D. A. Schutt, Peru, Ind., 594,908. Filed April 16, 1897. Constructed in such a manner that it may be removed from the block and replaced by a lamp.

ELECTRIC SWITCH. F. A. Gilbert, Brookline, Mass., 594,944. Filed Dec. 18, 1896. A push button switch in which the working parts are completely inclosed in a casing of insulating material.

MULTIPLE CIRCUIT BLOCK. D. A. Schutt, Peru, Ind., 595,078. Filed April 16, 1897. Details of construction.

MAGAZINE FUSE BLOCK. W. Ehrhardt, Union Hill, N. J., 595,244. Filed August 10, 1897. A rotary cylinder carrying a plurality of fuses and provided with contact clips.

Telephones:—

TELEPHONIC SELECTIVE SIGNALLING. J. A. Barrett, Brooklyn, N. Y., 594,979. Filed March 1, 1897. Details of system.

TELEPHONE CIRCUIT. G. K. Thompson, Malden, Mass., 595,004. Filed July 23, 1897. One battery is employed for calling from the substation, conversation purposes, the operation of the supervisory signals and to effect a satisfactory test.

CENTRAL STATION COMBINED TELEGRAPH AND TELEPHONE SYSTEM. A. C. Robbins, San Francisco, Cal., 595,241. Filed March 26, 1897. Details of construction.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED DECEMBER 14, 1897.

Alarms and Signals:—

RAILWAY SIGNAL. W. J. Fawcett, Pittsburg, Pa., 595,294. Filed Feb. 4, 1897. Means whereby passengers alighting from the rear end of a car may have warning of the approach of a car upon the adjacent track in an opposite direction.

ELECTRIC SIGNALING APPARATUS. W. E. Decrow, Boston, Mass., 595,375. Filed July 17, 1897. Police signal system in which two classes of signals are transmitted and may be audibly distinguished from each other.

ELECTRIC ALARM DEVICE. F. Louis, Brooklyn, N. Y., 595,398. Filed Jan. 7, 1897. Device for steam boilers, made to indicate either the maximum or minimum pressure required.

ELECTRIC SIGNAL INDICATOR. M. Mercier, Manchester, Eng., 595,575. Filed March 8, 1897. Apparatus for indicating the number of signals sounded. Adapted to mining work.

Batteries, Secondary:—

SECONDARY BATTERY. P. F. Ribbe, Berlin, Germany, 595,580. Filed April 7, 1896. An electrode for secondary batteries comprising a wooden frame, two celluloid plates connected by dissolved celluloid, the plates having openings with upturned edges, active material in the openings and a lead plate between the celluloid plates.

Conductors, Conduits and Insulators:—

INSULATED JOINT FOR GAS FIXTURES. J. W. Parkin, Philadelphia, Pa., 595,338. Filed Jan. 11, 1897. Details of construction.

JOINT FOR ELECTRIC CABLES. W. M. Brown, Johnstown, Pa., 595,367. Filed August 10, 1897. A T for electric cables comprising a metallic T-core uniting the naked ends of the cables, in combination with insulating material and a cover of soft metal for protecting the core and naked ends.

CONDUCTOR FOR ELECTRICAL APPARATUS. J. Mills, United States Army, 595,402. Filed March 27, 1897. Composed of thin strips of material which is both a conductor of electricity and also capable of being affected by and of readily transmitting magnetic force and having the laminæ separated by insulating material.

Distribution:—

TRANSFORMER. W. S. Moody, Lynn., Mass., 595,403. Filed Feb. 10, 1897. For three-wire systems.

METHOD OF AND APPARATUS FOR CONVERTING ELECTRIC CURRENTS. E. Thomson, Swampscott, Mass., 595,419. Filed Feb. 27, 1897. Consists of a primary wound for relatively high potentials, a secondary of low resistance, and another coil wound for high potentials, with means of suitably interrupting in sequence the circuits of the first two coils.

Dynamos and Motors:—

MEANS FOR GENERATING ELECTRICITY FROM CAR WHEEL AXLES. M. Moskowitz, Newark, N. J., 595,329. Filed May 17, 1897. Adapted for car lighting and heating systems.

SPACE BLOCK FOR ARMATURE CORES. A. F. Batchelder, Schenectady, N. Y., 595,364. Filed Sept. 15, 1897. Consists of an internal spider, a circumferential ring mounted on its arms and radial arms consisting of thin strips of metal mounted on the circumferential ring.

REGULATING ALTERNATING CURRENT DYNAMO ELECTRIC MACHINE. E. W. Rice, Jr., Schenectady, N. Y., 595,412. Filed Oct. 26, 1894. Comprises a dynamo with an exciter having a commutated armature connected with the field-coils of the main machine, and a transformer whose windings are respectively in circuit with the external circuit of the main machine and with the armature of the exciter.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. E. Thomson, Swampscott, and C. E. Harthan, Lynn., Mass., 595,420. Filed June 12, 1897. Enclosed arc lamp for constant potential circuits. Details of construction.

Measurements:—

ELECTRIC METER. W. D. Marks, Philadelphia, Pa., 595,325. Filed Sept. 10, 1897. Circuit controller for oscillating electric motors of electric meters.

PREPAYMENT ATTACHMENT FOR ELECTRIC METERS. J. Strachan and J. Nives, Saginaw, Mich., 595,446. Filed July 6, 1897. Comprises a train of spring actuated gearing carrying a rotating switch-bar forming part of the lighting-circuit and controlled by a pawl operated by a solenoid and means for energising the solenoid by the action of the coin actuated lever.

Miscellaneous:—

ELECTRICAL LIGHTER FOR BURNERS. S. M. Meyer, Brooklyn, N. Y., 595,327. Filed Nov. 6, 1896. Adapted for lighting oil lamps.

BLIND RAISED OR LOWERED BY MEANS OF ELECTRICITY AND SOLAR RAYS. E. Roth, Osnabruck, Germany, 595,343. Filed Dec. 5, 1896. Employs an electro motor and two transparent hollow bodies exposed to the rays of the sun to automatically raise and lower shades.

CONTROLLING DEVICE FOR ELECTRIC MOTORS. F. J. Russell, New York, 595,344. Filed April 22, 1897. Designed for motors applied to the turning of turrets on warships or the moving of rudders or guns.

ELECTRICAL CONTROLLING MECHANISM. F. J. Russell, New York, 595,345. Filed May 7, 1897. Similar to above.

FUEL ENGINE. C. K. MacFadden, Chicago, Ill., and E. F. Lloyd, Fort Wayne, Ind., 595,324. Filed May 14, 1896. Embodies an electric circuit, embracing an electromagnet arranged to bring the valve mechanism into contact with a vibrating lever so that such valve may be opened by positive mechanical means.

ILLUMINATING DEVICE FOR KEYHOLES. F. W. Roll and F. Waltman, Denver, Col., 595,444. Filed May 20, 1897. A small incandescent lamp is located within the lock casing, operated by a push button, projecting through the door.

MECHANISM FOR LINING METAL TUBES WITH PLIABLE MATERIAL. E. T. Greenfield, New York, 595,472. Filed April 29, 1897. Consists of means for inserting a previously formed tube of pliable material, such as paper, within a tube to be lined.

TUBULAR TRIPOD BRACE FOR LIGHTNING ARRESTERS. G. R. Kress, Pittsburg, Pa., 595,543. Filed Aug. 21, 1897. Comprises an upright tube incasing the upright end of the conductor cable and legs at its lower end, securing it to the building.

GALVANO CAUTERY INSTRUMENT. C. MacGregor Dayton, Ohio, 595,573. Filed Oct. 16, 1897. Handle for electrodes which enables their free manipulation in the hands of the person applying the instrument to the patient.

Railways and Appliances:—

ELECTRIC RAILWAY. J. R. Farmer, St. Louis, Mo., 595,293. Filed March 2, 1896. Surface contact system.

BREAKING ALTERNATING CURRENT INDUCTION MOTORS. E. W. Rice, Jr., Schenectady, N. Y., 595,413. Filed March 6, 1897. Consists in connecting the motor with a circuit capable of absorbing energy and passing through its inducing member an alternating magnetizing current of a frequency such that the motor will act as an induction generator.

CONTROLLING DEVICE FOR ELECTRIC RAILWAYS. R. M. Hunter, Philadelphia, Pa., 595,570. Filed Oct. 12, 1897. Comprises a motor circuit, motors supplied with current thereby, a counter e. m. f. regulator in the motor circuit, and a hand switch for varying the counter e. m. f., also cutting it out of circuit by completing the motor circuit around the counter e. m. f., generator, through an ohmic resistance.

ELECTRIC RAILWAY SYSTEM. M. J. Wightman, Scranton, Pa., 595,590. Filed Aug. 10, 1896. Employs disconnected sections of working conductor and a continuous flexible current conveyor adapted by magnetic attraction to close the circuit between the sections and the source of supply.

TROLLEY STAND. S. H. Short, Cleveland, Ohio, 595,659. Filed Sept. 26, 1896. A trolley stand supporting a trolley in such manner that it may have free vertical motion, but no lateral motion when in service, but reversible when desired.

ELECTRIC RAILWAY MOTOR. E. D. Priest, Schenectady, N. Y., 595,409. Filed Feb. 23, 1897. Comprises a field magnet enclosing the armature boxes mounted in cut-away portions of the field magnet and separable therefrom; armature shaft bearings mounted in boxes, and means for securing the boxes to the magnet frame.

Regulation:—

ELECTRIC REGULATOR. M. Moskowitz, Newark, N. J., 595,330. Filed May 26, 1897. Designed for use in car lighting systems in which the motor is driven by the car axle.

Switches, Cut-Outs, Rheostats, Etc.:—

RHEOSTAT OR ELECTRIC HEATER. F. Kraemer, Chicago, Ill., 595,395. Filed Jan. 23, 1896. Consists of solid carbon sticks of high resistance completely embedded in a plastic material composed of barite or its equivalent and silicic acid.

INCANDESCENT LAMP SOCKET. D. A. Schutt, Peru, Ind., 595,594. Filed April 16, 1897. Three part socket. Details of construction.

FUSE BLOCK. D. A. Schutt, Peru, Ind., 595,585. Filed April 16, 1897. Comprises a circular, dome-shaped hollow body of insulating material in which the block carrying the fuse is adapted to fit.

COMBINATION ATTACHMENT PLUG. J. F. Gates, Pittsburg, Pa., 595,619. Filed Feb. 19, 1897. Consists of a plug proper, having a detachable reversible contact pin provided with heads of differential sizes.

AMERICAN STOKER CO., OF BROOKLYN.

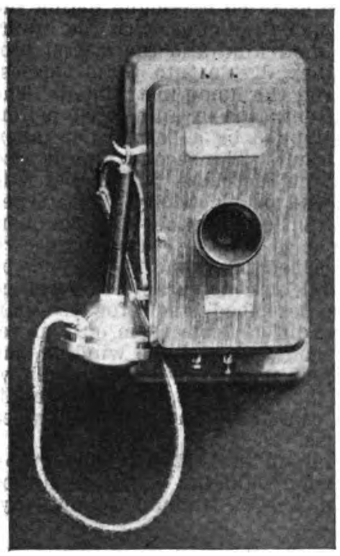
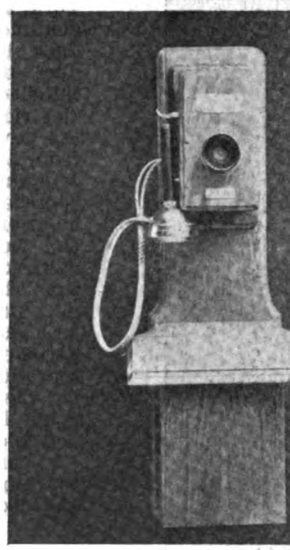
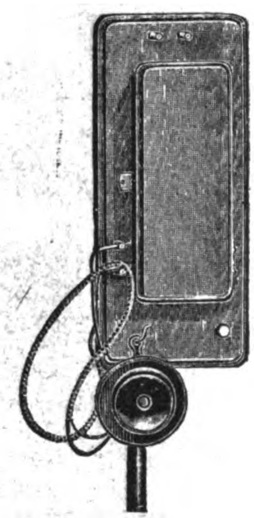
The American Stoker Company of Brooklyn has been incorporated with a capital of $500,000 to purchase the franchises of the American Stoker Company, of Dayton, O., and to manufacture stokers and other tools. The directors are: Royal C. Peabody, David H. Valentine, Alfred J. Couch, Frank H. Field, Henry Batterman, Hugh W. Fullerton and William S. Barstow, of Brooklyn.

TRADE NOTES & NOVELTIES

THE COSMO TELEPHONES.

THE Cosmo Electric Company, of 30 West Randolph street, Chicago, have brought out a line of telephone instruments for which they claim high merits combined with cheapness. Their "Cosmo" No. 1 instrument is adapted for use in intercommunicating systems, long distance telephony and private lines, or in fact in any situation where a switchboard, drop or polarized bell is not used. It is adapted to have its batteries connected with the two bottom binding posts, and the batteries are placed on the floor of closet or cellar. This instrument is also made with polarized bells.

The "Cosmo" No. 2, illustrated in Fig. 1, is very nearly the same in construction, the difference being that in No. 2 two dry batteries are incased in the box, the internal diameter of the box being 3 x 3 and 16 inches long. These are also intended to be used under the same conditions as "Cosmo" No. 1; that is, where no switchboard or polarized bells are used. The signal in both these styles of telephones is made and emitted by the receiver. It gives a harmonic tone of any pitch desired and is quite musical. The "Cosmo" No. 2 is especially designed to meet the requirements of a telephone where parties want to use them in a room where batteries are undesirable.

FIGS. 1, 2 AND 3.—COSMO ELECTRIC CO.'S TELEPHONES.

The "Cosmo" exchange telephone, Fig. 2, is put on the back board the same as other exchange telephones, battery box at the bottom, and is adapted to work drops and ring polarized bells.

The Cosmo Company also make a "Harmonic" telephone, Fig. 3, which employs the same kind of signal, the receiver being used as transmitter and receiver both.

Carbon ball transmitters are used in all the company's instruments, each having four balls only, and they are claimed to be the equal of, if not superior to, the granulated carbon type. Two battery cells are used on all these telephones for all distances. All the instruments which are adapted to ring bells and work drops can be used in connection with any style of telephone or switchboard. With the "Cosmo" exchange telephone polarized bells wound to any degree of resistance can be rung through 1,000 ohms and, it is claimed, make the "harmonic" signal farther than a standard magneto will ring a bell.

The "Cosmo" transmitters do away with the magneto generator which represents about one-half the cost of the telephone. In all of their telephones to signal one pushes a button instead of turning a crank.

THE ELECTRIC STORAGE BATTERY COMPANY has earned to date in this fiscal year, which closes December 31, $950,000 gross. Aside from this there is the contract with the Electric Vehicle Company, which makes the total in excess of $1,000,000.

APPARATUS FOR WIRELESS TELEGRAPHY.

After months of experimenting, the U. S. Electrical Supply Company, of 120 Liberty street, New York, are now placing upon the market a complete line of apparatus for wireless telegraphy. Mr. W. J. Clarke, the general manager of the company, was the first in this country to give a public exhibition of the Marconi system, and states that the apparatus which his company is manufacturing is not only low in price, but is in many ways a great improvement upon the Marconi system. The demonstrations made by Mr. Clarke with it have been very successful, and the sets he supplies answer all purposes of ordinary experimentation.

THE NEW COMPLETE CATALOGUE OF EDISON INCANDESCENT LAMPS.

This catalogue recently issued by the General Electric Company is nothing more or less than a treatise on incandescent lamps from the customer's point of view. The catalogue begins with introductory chapters on the "Production, Selection and Use of Lamps." In these are set forth in a concise manner the methods employed in producing the Edison lamp and an account of the importance and value of skill and experience in lamp production, advice how to select the type of lamp best suited to the purchaser's conditions, and the necessary requirements for the proper use of lamps. Descriptions of the various types of lamps follow the introduction, and a full-sized illustration accompanies each lamp described. The descriptions and illustrations include every class of lamp manufactured by the General Electric Company, of which there are over 30,000 varieties, including the various voltages and candle-powers, etc., and of which the General Electric Company produce and sell annually over 6,500,000.

Following the description of the lamps is an "Appendix of Information on Incandescent Lamps" of great value to all lamp users. The opening discussion is on the "Life and Candle-Power of Lamps," in which the subject of decline of candle-power and its bearing upon the lamp renewals is clearly set forth. Following this is a chapter on the "Importance of Good Regulation," and additional chapters on the "Method of Measuring Lamp Value by Candle-Power Area," "Special Points to be remembered in the use of Lamps," "Faults in Incandescent Lamps," and tables of lamp data. The concluding chapters of the appendix are given to the subject of "General Illumination" and "Correct Use of Light," and "How to Avoid Harmful Effects on the Eyes."

The catalogue is, in short, a very interesting commercial treatise on incandescent lamps. Its typography is excellent, and the illustrations of the lamps are well designed and executed. Copies have been sent to all station managers in the United States, and can be obtained from the General Electric Company's Lamp Works, Harrison, N. J., or at the nearest local office.

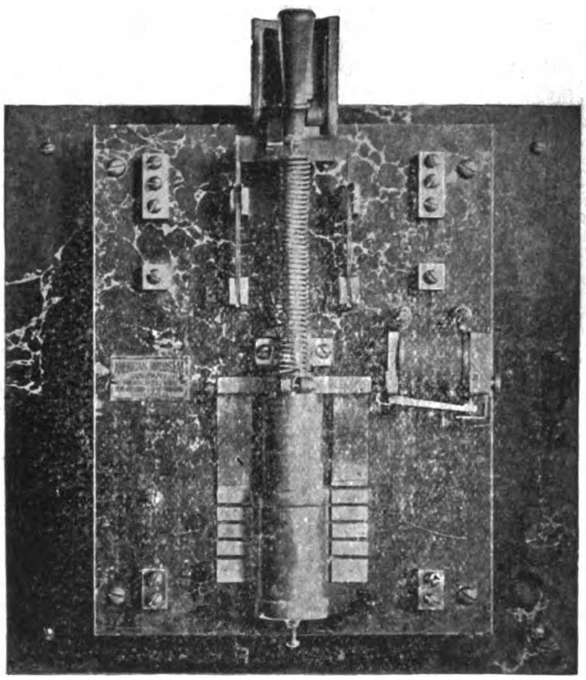
RAPID TRANSIT.—The New York Court of Appeals has handed down a decision virtually in favor of the rapid transit underground scheme, but with many onerous conditions attached, one being a bond for $15,000,000. The outlook remains dubious.

THE PERFECTION STARTING RHEOSTAT.

THE satisfaction derived from the use of their automatic boxes has led the American Rheostat Company, of Milwaukee, Wis., to develop the "Perfection" starting rheostat, combining in one apparatus an automatic starting box and a complete switchboard. It consists of a double pole knife switch, a double pole fuse block, an automatic release and overload mechanism, and a double pole circuit breaker, handsomely mounted on marbelized slate, as shown in the accompanying engraving.

To start the motor it is only necessary to close the knife switch, the remaining operation of cutting out the resistance being entirely automatic. The knife switch, however, will not remain closed when the current is not passing through the line. The release and overload devices act through a double pole knife switch, thus opening both lines and thereby, it appears, complying with the strictest requirements of the fire underwriters.

Its installation is very simple, merely necessitating its attachment to the wall in the most convenient place and the connection of the mains and motor wires. It makes a handsome, compact and complete switchboard and saves the cost of additional switches, fuse blocks, connections and mounting board.



The Perfection Starting Rheostat.

The American Rheostat Company, of Milwaukee, has enjoyed a rapid growth since its incorporation in the spring of 1896. The directors of the company lately found it necessary to vote an increase of the capital stock to $25,000 to enable the company to take care of its constantly increasing business. Its officers are all progressive men of ability and have been untiring in their efforts to make the business a successful one, and the popularity of the "American" rheostats is a sufficient comment upon the result of their endeavors. The officers of the company are as follows: Frank R. Bacon, president; F. E. Herdman, vice-president; J. Gilbert Hickcox, secretary and treasurer. A finely equipped plant will shortly be erected and the factory will then be moved from its present quarters. The company expects, with its improved facilities, to materially increase its output.

THE CLEVERLY CALENDAR.

The Cleverly Electrical Works are presenting their friends with a very handsome calendar for 1898. On a heavy Bristol board, 15 by 21 inches, is mounted the pad printed in neat but tasteful type. The really artistic feature is a photogravure in a cool green tint, portraying beautifully an old New England mill, a placid stream reflecting the picturesque building and the trees along its banks. The name of the Cleverly Electrical Works, 1018 Chestnut street, Philadelphia, appears in script below the engraving. The calendar cannot fail to ornament any office whose occupant may be fortunate enough to secure one and to remind him that the Cleverly electrical specialties retain all their old excellence, and many new features lately added.

CARLOS BRIGHT'S LATEST CATALOGUE.

We have received an interesting pamphlet from the engineering department of the house of Carlos Bright, 874 Calle Cuyo, Buenos Ayres, S. A., which sets forth in tabulated form the installations for the year ending July 1897. The list is a long one, leaving no department of electrical engineering unrepresented, and it is gratifying to note how extensively the apparatus of manufacturers within the United States has been adopted. Among these may be mentioned the General Electric Company, for whom Mr. Bright is the sole agent in the Argentine; McIntosh, Seymour & Company, engines; Fuel Economizer Company, fuel economizers, and Otis Bros. & Company, elevators. Besides these are supplied arc and incandescent lamps, electrical supplies, railway material and motor-driven ventilators. Mr. Bright also undertakes the design and construction of electric cranes and hoists.

Taken as a whole, it cannot fail to show the rapid development of electrical interests in the Republic.

PHONOGRAPHS.

Messrs. J. H. Bunnell & Company, 76 Cortlandt street, New York, are now distributing an illustrated catalogue listing the genuine Edison phonograph which they offer with the assurance that they are the best of their kind and the lastest product of the inventor. These they divide into three classes; the electric, the spring motor, and the home instrument. The electric or class "M" machine is actuated by an electric motor, the power for which may be supplied by a battery, or taken from a 110 or 220 volt street circuit. The second type is also of standard make and differs from the class "M" in that it is operated by spring power instead of electricity. The types mentioned are designed for exhibition purposes and commercial work. In the latter case it is always ready to receive dictation, which may be transcribed later and the saving of time thus effected will be found of considerable importance in a busy office. The third type described is sold for less than half the price of the others and differs from them only as regards the length of time it will run with a single winding, the reproductions, however, being just as loud and clear. Following the phonographs are listed the accessories, such as amplifying horns, musical records, cases, multiple hearing tubes and special phonograph batteries.

A complete illustrated manual of the Edison phonograph containing a world of information valuable to the exhibitor and user may be obtained from Messrs. Bunnell & Company.

SIPE & SIGLER AND THE WILLARD STORAGE BATTERY.

NEWS reaches us from Cleveland, O., that the Willard Electric and Battery Company have been absorbed by Sipe & Sigler, and that the manufacture of the Willard storage battery will be henceforth conducted on a most extensive scale under that firm's name.

The firm of Sipe & Sigler have long been known as the leading manufacturers and wholesalers of jewelry in Ohio's Metropolis. They are also the manufacturers of the well-known American filled watch case and Cleveland watch chains and are the sole owners of both the American Filled Case Company and the Cleveland Chain Company, both of which enterprises they now retire from to give their full financial weight and personal attention to the manufacture and sale of the Willard battery.

Both Messrs. Sipe and Sigler are young men, yet they have forged to the front ranks of Cleveland business men, and they are well known for their business acumen and enterprise. In the deal that has just been consummated, Mr. Theodore A. Willard, the inventor of the battery which bears his name, and H. M. Hawley, have become members of the firm of Sipe & Sigler.

This deal was brought about by popular demands for the Willard battery which far exceeded the capacity of the Willard Electric and Battery Company to supply. In fact they were obliged to turn away monthly many thousands of dollars worth of orders owing to their lack of factory capacity and finance to execute them. They were thus compelled to look about to invest more capital in the enterprise, and the factory being for nearly two years past located in the power building of Sipe & Sigler, it is but natural that they should have been approached first.

The manufacture and sale of the batteries will still be conducted in the fine Sipe & Sigler power building. It contains six stories and a basement, and each floor is 35 x 165 feet in size. The entire building will be devoted to the manufacture

of the Willard storage batteries of all types and sizes, each one adapted to its own particular use. Batteries will be made suited to light a miniature incandescent lamp or to illuminate a great city, to operate a mechanical toy or the largest street railway system.

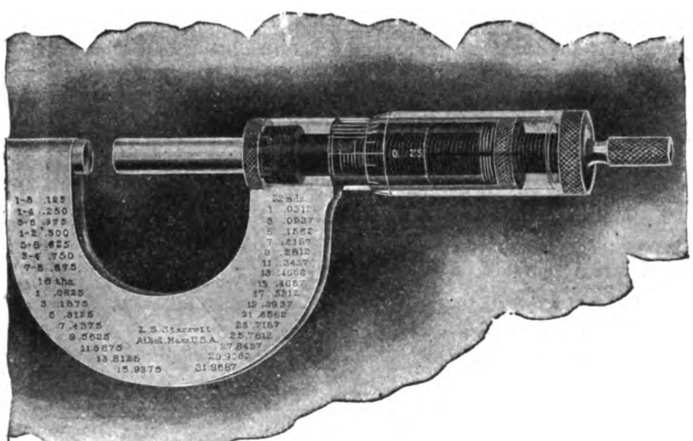
The basement will contain the power plant and the system of generators; also a storage battery for the lighting of the building and for the economic supplying of power. The different floors are being equipped with the finest special machinery and preparations are being made throughout to run the plant continuously the full twenty-four hours.

The first floor will be devoted to the electro-chemical process known as forming; the second to the offices, laboratory, drafting and engineering departments; the third will be devoted to assembling and other kindred operations; the fourth and fifth will be equipped with special machinery for the manufacture of the plates and other parts, and the sixth will be devoted to the manufacture of the concentric form of Willard battery, which has so suddenly sprung into popular favor owing to the many advantages of its peculiar and original construction.

The building was designed especially for fine manufacturing purposes by Messrs. Sipe & Sigler, and is especially well suited for the same, being most perfectly lighted from all sides. It is equipped with the General fire extinguisher apparatus and can comfortably employ nine hundred operatives.

STARRETT MICROMETERS.

L. S. STARRETT & COMPANY, of Athol, Mass., have won a well deserved reputation for their fine mechanical tools of all descriptions, as well as for their milling and other cutters. Probably their beautiful and accurate micrometers are as well known as any of their lines, and in electrical work the demand for close precision makes them a distinct boon. Catalogue No. 15, just issued by the concern, has several of its 112 well filled pages devoted to this line of instrument, and we illustrate herewith in interior perspective their standard form. A number of excellent features commend these specialties. A graduated shell with reading line covers the split nut and shank of the frame, and may be rotated to bring the reading line correct to compensate for wear, using the special wrench provided for that purpose. The shell also



THE STARRETT MICROMETER.

keeps dirt away from the screw, and it is practicable to insert a new screw and have it read correctly by adding a new shell with reading line—all of which is much better than throwing away the whole thing if a part gets broken or worn out. Another feature is the small knurled thumb piece, speeding the screw about 3 to 1 and reducing leverage, so that a closer, surer measure is taken. There is also a knurled locking nut contracting, as will be noted, a split bushing around the spindle, taking up wear centrally and truly, or locking firmly by a slight turn and making a solid gauge when desired. There are other features all patented and peculiar to these Starrett micrometers, which are now more popular than ever.

STORAGE BATTERIES IN THE BUFFALO RAILWAY POWER HOUSE.

THE Buffalo Railway Company have decided to install a storage battery plant in connection with their power house on Niagara street, in Buffalo. The size of this plant will make it one of the most notable improvements and departures seen in the street railway field in a long time. The contract for the battery has been awarded to the Electric Storage Battery Company, of Philadelphia, Pa., and when it is completed and installed, which is expected to be some time in March next, it will be operated in conjunction with the steam and converter plant now used by the company.

The battery will be charged from the converters. Should there be a surplus of power from the Niagara transmission at any time, or if more steam is being made than is necessary to operate the street car lines at any time of the day, the battery will take up the surplus power. The greatest demand on the power of the Buffalo company is at about 6 o'clock in the evening.

The battery that the Buffalo company propose to install will be of 1,200 horse power hours. It will have 290 cells, and each cell will weigh 1,200 pounds. The battery tanks will occupy a floor space of 2,800 feet. A new fireproof building will be erected adjoining the power plant on Niagara street, in which the storage battery will be placed. This building will have a frontage of 40 feet, and a depth of 70 feet. Work on it will be commenced at once.

The company have made very careful inquiry into the merits of the battery, and so great is their faith in it that the tanks in which the cells are to be placed will be considerably larger than necessary to meet present requirements, so that without enlarging the tanks they will be able to add plates which will increase the power of the battery 66⅔ per cent. The adoption of the storage battery is quite in line with the progressive spirit of the company, which claims to have been the first company to use elctric generators direct connected to the engines. It was also the first user of Niagara power in Buffalo, and it is in connection with the use of this power that the company expect profitable results from the storage battery. The Niagara Falls Power Company supply the Cataract Power and Conduit Company, which company act as distributors of Niagara power in Buffalo, with a 24-hour service. As the lines are not all operated all night, it is expected that there will be some surplus power for the battery to take care of, saving it as reserve power to be used when the demand is heavier.

ADVERTISERS' HINTS

THE ELECTRIC APPLIANCE COMPANY, 242 Madison street, Chicago, say that by reading their red catalogue of electrical supplies a knowledge is obtained of the latest goods at the lowest prices and the place where they are shipped the most promptly.

THE ANCHOR ELECTRIC COMPANY, Boston, advertise "Anchor" flush snap switches and draw attention to their excellent workmanship, reliability and design.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, Ohio, have opened an office at 10 and 12 North Ninth street, St. Louis, for the sale of their arc lamps for all circuits. They are finished in black Japan, oxidized copper, brass, etc., and include a large variety of enclosed and open arcs.

THE KENNEDY VALVE MANUFACTURING COMPANY, 75 John street, New York, advertise extra heavy valves for high pressure steam plants and also globe, check, radiator and safety valves.

THE MANUFACTURERS' AND INVENTORS' ELECTRIC COMPANY, 96 Fulton street, New York, undertake experimental work and furnish models, supplies, graphophones and records.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., state that the Westinghouse apparatus is never supplanted, but is recognized as standard throughout the world.

HUGO REISINGER, 38 Beaver street, the New York agent for the "Electra" high grade Nuernberg carbons, publishes notice to the effect that the "Electra" brand is manufactured by the firm of C. Conradty, Nuernberg, the oldest and largest carbon works in existence, and that prosecution will follow the infringement of his trade mark.

THE BILLINGS & SPENCER COMPANY, Hartford, Conn., continue to manufacture and sell drop forged pure lake copper commutator segments for all standard street railway motors.

A CONDUIT IS COMING which will cause a sensation if half the claims made for it are substantiated.

C. B. STERLING & COMPANY, 120 Liberty street, New York, advertise electrical supplies of all kinds, shippers' marking crayons and the tampograph.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., have another iron roof for sale at a bargain. It was designed for a machine shop, but the purchaser's failure compels the offer.

THE C & C ELECTRIC COMPANY, 143 Liberty street, New York, claim to be pioneers in electric power transmission

and recommend the selection of C & C multipolar generators and ironclad motors.

THE STANDARD AIR BRAKE COMPANY, 100 Broadway, New York, advertise a large variety of apparatus for air compression and braking.

PRATT & WHITNEY COMPANY, Hartford, Conn., advertise milling machines. Their large catalogue will prove interesting to users of machine tools.

SIPE & SIGLER have succeeded the Willard Electric and Battery Company, Cleveland, and will continue the manufacture of Willard batteries.

THE COSMO TELEPHONE COMPANY, Chicago, illustrate one style of their telephone. Other instruments manufactured by them are described elsewhere in this issue.

NEW ENGLAND NOTES

ALPHEN'S IMPROVED BELT DRESSING is giving excellent satisfaction wherever it is being used. It is one of the best belt dressings now on the market, and is warranted to prevent belts from slipping, at the same time preserving the leather or rubber. Mr. Wm. Alphen, Gloucester, Mass., the inventor and manufacturer of this dressing, has quite a number of testimonial letters from power plants using his goods. He will take pleasure in sending samples with price to interested parties.

THE JACKSON & WOODIN MANUFACTURING COMPANY, of Berwick, Pa., are extending their foundry building by an addition which covers practically one-half the ground of the original foundry. The construction of the new portion will be similar to that of the present building, having steel trusses supporting the roof and carrying the trollies for transporting material over the foundry floor. They have given the contract for furnishing and erecting the steel work to the Berlin Iron Bridge Company, of East Berlin, Conn.

MR. STEPHEN E. SHAW, treasurer of the Strange Forged Drill and Tool Company, New Bedford, Mass., reports very satisfactory sales of their forged twist drills, said to be the best in the market, also chucks, rose reamers, and machinists' tools. Their factory is running very busy with a full force of men and prospects for the new year are very encouraging indeed.

WESTERN NOTES

THE KURTZ NATIONAL TELEPHONE COMPANY of the State of Indiana has been duly incorporated for $50,000, and the following officers were elected: William H. Dye, president; J. V. Mitchell, secretary; John N. Cobb, treasurer; William J. Kurtz, vice-president and manager. This State company has a model plant in operation at Martinsville, Ind., with 230 telephones, and four towns connected up by toll lines; and is authorized to do business in every county in the State.

CENTRAL TELEPHONE AND ELECTRIC COMPANY, 1123 Pine street, St. Louis, Mo., are now making all the instruments previously made by the D. A. Kusel Telephone Company. Mr. R. T. Durrett is in charge of the financial end of the business, while Mr. J. S. Cuming attends to the practical management of factory, etc. The Central Company invite correspondence.

WESTERN ELECTRIC COMPANY.—Six stories are to be added to one of the buildings of the Western Electric Company on the block bounded by Clinton, Van Buren, Jefferson streets and Jefferson place, after plans by Samuel A. Treat, architect. The building is 174 x 56 feet, and as it now stands is two stories high. The additional stories will be of steel construction, thoroughly protected by brick and tile. Wire glass will be used in the windows. The improvement will cost $100,000.

NEW YORK NOTES

MR. SETH C. ADAMS, who is to represent the Walker Company at Utica, N. Y., and thereabouts, has taken offices in the Mann Building in that city.

MR. F. A. SCHEFFLER in becoming superintendent of the Sprague factory will have a position for which long training, ripe experience and many excellent qualities fit him most thoroughly.

H. B. COHO & COMPANY, St. Paul Building, New York, have recently added to their already long list of companies represented by them, the names of Van Horne Burger & Company, manufacturers of the "Van" gas engine; the American Rheostat Company, and the Translucent Fabric Company. The line of goods now handled by this company represents many different makes of instruments and machines, thus bearing out their motto: "Complete Electrical Equipment."

"HABIRSHAW."—Cards are out as usual for the celebration of New Year's Eve at the Habirshaw offices, 15 Cortlandt street, with Mr. J. W. Godfrey, as master of the ceremonies. The function will begin in the early afternoon and last until the guests go home.

CONTENTS.

Department News Items will be found in advertising pages.

The Electrical Engineer.

Vol. XXIV. DECEMBER 30, 1897. No. 504.

THE ELECTRICAL EQUIPMENT OF THE AMERICAN LITHOGRAPHIC COMPANY BUILDING, NEW YORK CITY.

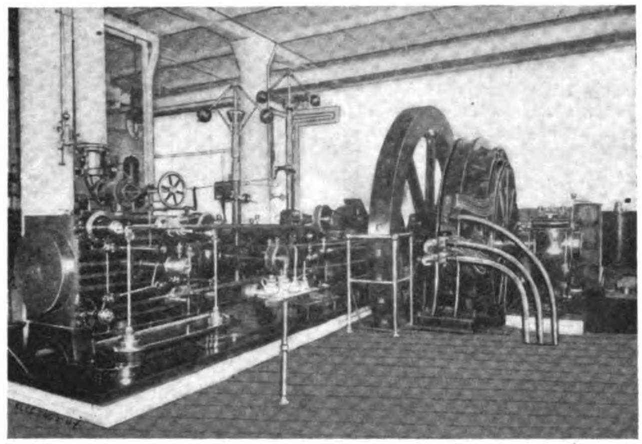
INTRODUCTION.

FEW industries have been so vitally affected of late years by mechanical improvements as that of printing and its allied trades and branches. The modern perfecting web press and the later lithographic color presses alone embody much of the best thought and invention of the times, and they are but parts of a great whole, every detail of which has been lifted to a very high plane of achievement by the strenuous efforts required from men and machines alike when pitted against the exacting conditions of the "art preservative." Production on an enormous scale, large orders to be delivered within a minimum contract time, cheapness to an undreamt of ex-

BUILDING OF THE AM. LITHOGRAPHIC CO., FOURTH AVE AND EAST NINETEENTH STREET, NEW YORK CITY.

tent, fine quality of a marvelous exactitude, and dividends to earn on the investment in costly apparatus and refined methods —all these conditions have had to be met. It is not the least of the interesting signs of the times that in a plant such as that of the American Lithographic Co. in this city—the consummate flower of the printing art—resort should be made to electricity in many of its protean forms, and that the establishment should be generally regarded as the finest exemplification of the furthest reach of the best ideas in lighting and power that could be pointed to at the present day, in this or similar important fields of work.

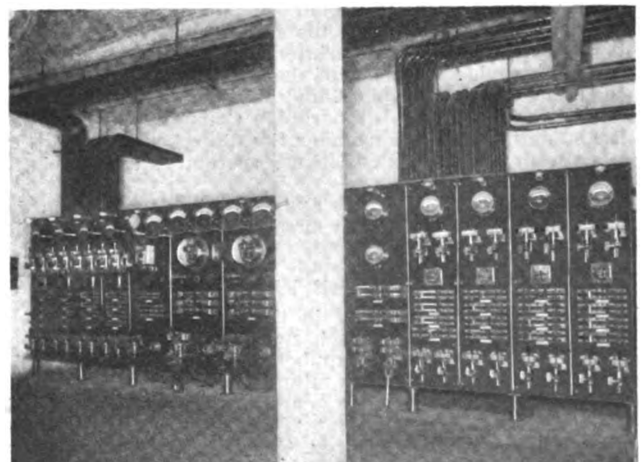
The American Lithographic Co. is the outcome of a consolidation effected in 1892 of ten of the largest lithographic concerns in the Eastern States, operating nine different plants, with all their varieties of product, local conditions, power equipment, etc., while obviously many of the power plants were inefficient with attendant high insurance, poor lighting and other drawbacks. It soon became evident that a consolida-



ONE UNIT, WATTS-CAMPBELL ENGINE AND GEN. ELECTRIC GENERATOR, AM. LITHOGRAPHIC CO.'S PLANT.

tion of productive capacity was needed, to secure all the possible and latent economies, and at last in 1896 the construction of such a concentrated building and plant was begun on Fourth avenue, between Eighteenth and Nineteenth streets, New York City. Our illustration gives a fair idea of the fine thirteen-story, steel frame structure, with basement and roof house, having a frontage of 131 feet on Fourth avenue and 200 feet on Nineteenth street, and being divided to all intents and purposes into two distinct sections or wings, East and West. This building it was early determined to equip throughout with electric power, as well as electric light, and Messrs. Ford, Bacon & Davis were retained as consulting engineers for all that work. To describe the plant briefly as installed by them, and as it is in operation to-day, is the object of this article, and it may be noted in passing that very seldom does it fall to the lot of the electrical journalist to comment on anything so perfect and thorough, so well thought out, or so well carried out.

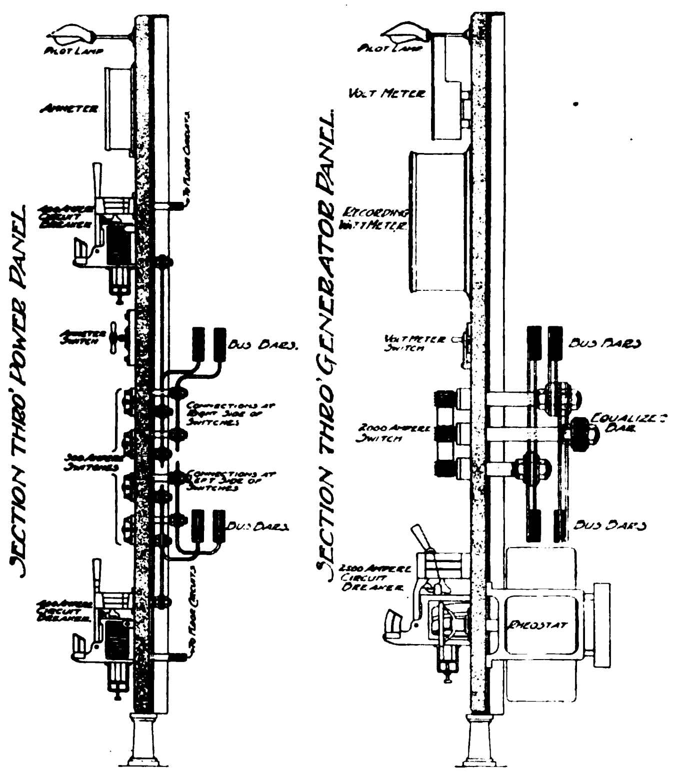
Before entering upon the description it may be noted that the building is of the most substantial fireproof character, its floors being specially strong in order to carry presses and other big machines by the score, as well as lithographic stones enough to pave the sidewalks of a good-sized city. Another point to make is that the American Lithographic Co.'s work



SWITCHBOARD, PLANT OF AMERICAN LITHOGRAPHIC CO., N. Y.

ranges through several classes and groups of color printing, job work, advertising matter, gilding, embossing, etc., and includes publications of various kinds, such as "Truth."

The roof house is occupied by the photographic department, and the top floor shelters artists and provers. On the twelfth floor are the stone planers and transfer presses. The tenth and eleventh floors contain cutting, folding, embossing and finishing machinery, and the storage and shipping departments. On the ninth floor are the compositors and a huge number of type-



SECTIONAL VIEWS, SWITCHBOARD BUILT BY N. Y. ELEC. EQUIPMENT CO.
(From the designs of Ford, Bacon & Davis, Engineers).

presses. The three floors below are nearly all given up entirely to the mammoth lithographic presses, numbering about one hundred. The fifth and fourth floors house stock and printed material, such as labels, etc. A large part of the third floor carries tons of lithographic stones, with some of the offices, the main offices being on the second floor, with a superb art gallery of famous pictures reproduced by the company. There is a fine large street entrance with grand stairway opening into the art gallery. The first floor has a number of large stores rented to different firms, and finally comes the basement, with its store cellars, machine shop and power plant.

The officers of the American Lithographic Company are as follows: President, Joseph P. Knapp; first vice-president and purchasing agent, George W. Donaldson; second vice-president, R. M. Donaldson; treasurer, Louis Ettlinger; secretary, John R. Giles. Charles Eddy is superintendent of the company and William Hickey chief engineer of the power plant. The building, including the power plant and wiring construction, was erected for the American Lithographic Company by the Central Real Estate Association under the direction of George P. Slade, treasurer, Alfred R. Kirkus, secretary, and Richard Berger, architect.

All the ventilating and steam apparatus in general was designed and installed under the supervision of Mr. Alfred R. Wolff, consulting engineer.

THE POWER PLANT.

The electric generating plant in the basement of the west wing consists of two 20x36-inch non-condensing Corliss engines, made by the Watts-Campbell Co., of Newark, N. J., running at 120 revolutions per minute, each direct connected to a 200 k. w. General Electric generator, and one 10x14-inch Straight Line engine running at 285 revolutions per minute and direct connected to a 40 k. w. General Electric generator. Space is reserved in the engine room for a third 200 k. w. unit. The Corliss engines are extra heavy throughout to meet the severe conditions. Each flywheel weighs 34,000 pounds, and at the stated speed a very close regulation is obtained, well within the specified limit, viz., 2 per cent. under a variation of load of from 40 per cent. overload to no load, this variation being obtained by tripping the main circuit breaker. The speed is high for Corliss engines, but they work in a most satisfactory manner. The cranks are of the balanced disc type, and the steam and exhaust valves are operated by separate eccentrics to increase the capacity of the engines for overloads. An additional safety governor has been attached to each engine, so constructed as to stop the engine by means of a butterfly valve in the steam admission pipe when the engine runs more than 10 revolutions above the normal speed. The engine room and foundations are below the level of the sewer, so that it was necessary to waterproof all openings in the foundation work, and provide water-tight flywheel pits for engines and generators. The Straight Line engine is a standard engine of this class and was installed to provide for the night lighting load of the plant with a small G. E. ironclad generator with drum armature.

The 200 k. w. generators are of the "smooth body" type, such as are used in Edison central stations, but are compound wound instead of shunt, and are provided with out-board bearings. The data of these machines are as follows: Number of poles, 10; speed, 120 revolutions per minute; height, 99 inches; floor space, 35x146 inches; diameter of shaft, 11 inches; approximate weight of armature, 9,600 pounds; approximate weight of dynamo, 24,500 pounds.

There are as many commutator segments as the armature has bars. Copper gauze brushes are used and the brushes are carried on a brush ring. The foundations for the units are remarkably solid and free from vibration, extending down to the bed rock, with hard burned brick and Dyckerhoff cement mortar. The foundations are capped with a sole plate whose elevated edge imprisons oil and water drip. From the generators current is carried to the switchboard by heavy Habirshaw red core cable, lead sheathed, and served with hemp above exposure line. The cables are carried in strictly waterproof trenches, readily accessible by iron covers, and are held on insulating bridges. The connections to the 200 k. w. generators are of 3,100,000 c. m. section, with .5 volt loss between machine and bus-bar. The equalizer connections are

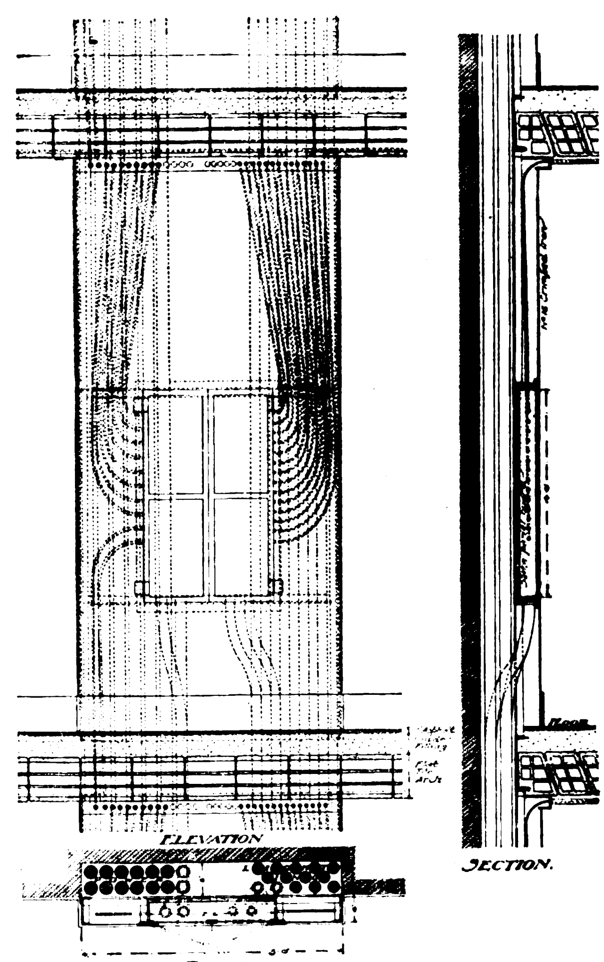
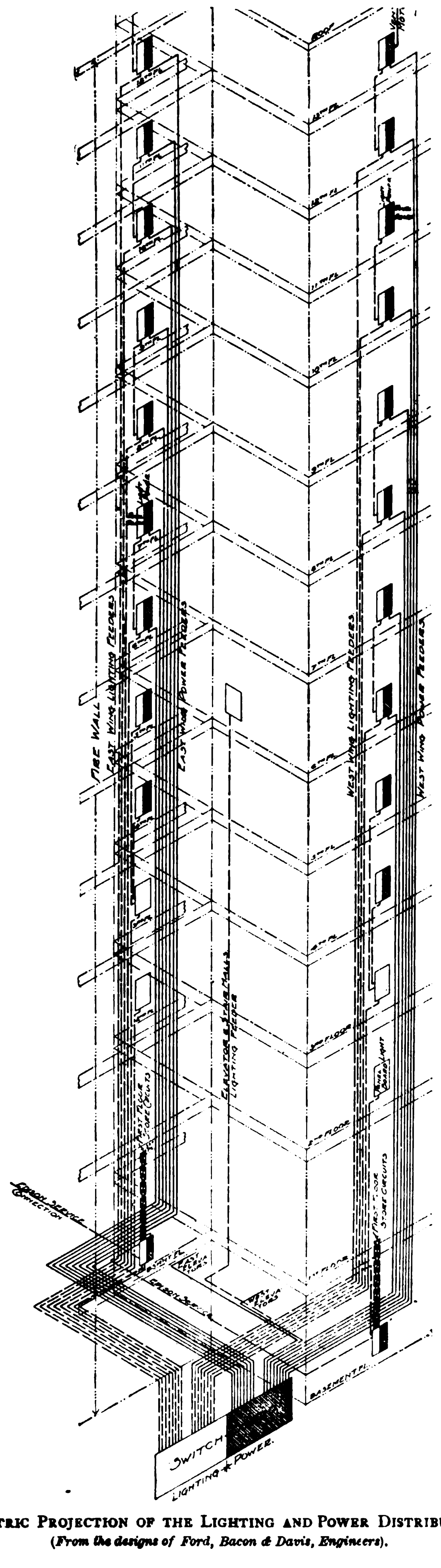


DIAGRAM OF PANEL BOARD AND WIREWAY.
(From the designs of Ford, Bacon & Davis, Engineers).

of the same capacity. The small night unit has connections of 375,000 c. m. capacity.

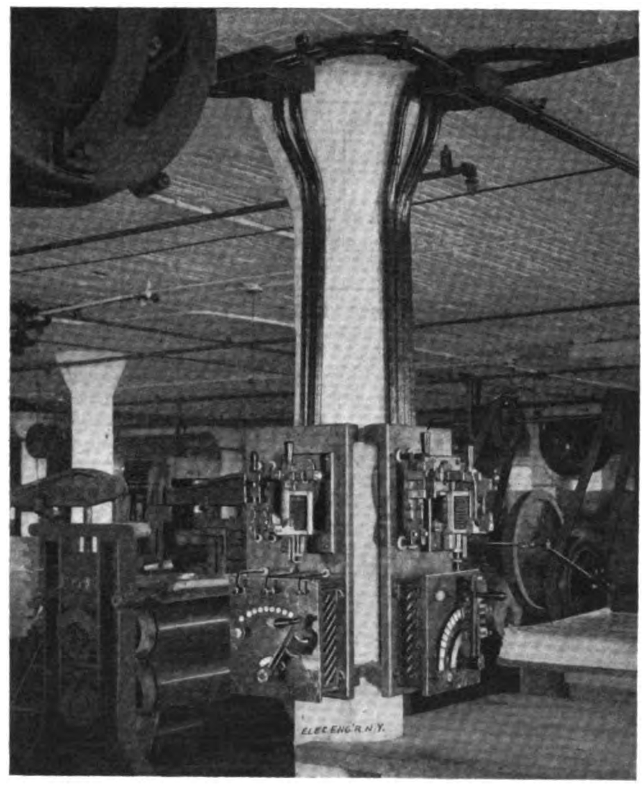
SWITCHBOARD AND DISTRIBUTION.

The handsome switchboard was built by the New York Electric Equipment Co, and is 28 feet 10 inches long, 7 feet 6 inches



Isometric Projection of the Lighting and Power Distribution.
(From the designs of Ford, Bacon & Davis, Engineers).

high and is mounted on massive 7-inch metal pedestals. Its framework is angle and T iron, bolted together and anchored to the wall, with ample space at the rear. The panels are of polished black enamel slate 2 inches thick. The board is in three main sections, current being delivered to the middle one, with lighting and power on either hand, and one panel being left blank for extensions. Each panel, for whatever purpose, is separate and distinct. There are 16 lighting feeder circuits and 16 power circuits, besides 2 elevator circuits, and each panel has the switches, circuit breakers, fuses, etc., for four feeder circuits, a Cutter automatic circuit breaker protecting each feeder circuit. One ammeter will read any one of the circuits. There is on each of the generator panels a Thomson recording wattmeter, besides Weston voltmeters and ammeters, Bristol recording voltmeter and Carpenter enamel rheostats. Two independent sets of bus-bars extend the full length of the board, which with the double-throw generator and feeder switches enables two combinations of any generator or circuit. All flexible connections are in flexible conduit, and at the top of the board are bolted iron spacing plates to which the steel armored conduits for the feeders



Method of Conduit Wiring on Columns to and From Motors on Ceiling.

are brought and fastened, provision here as elsewhere being carefully made for extension.

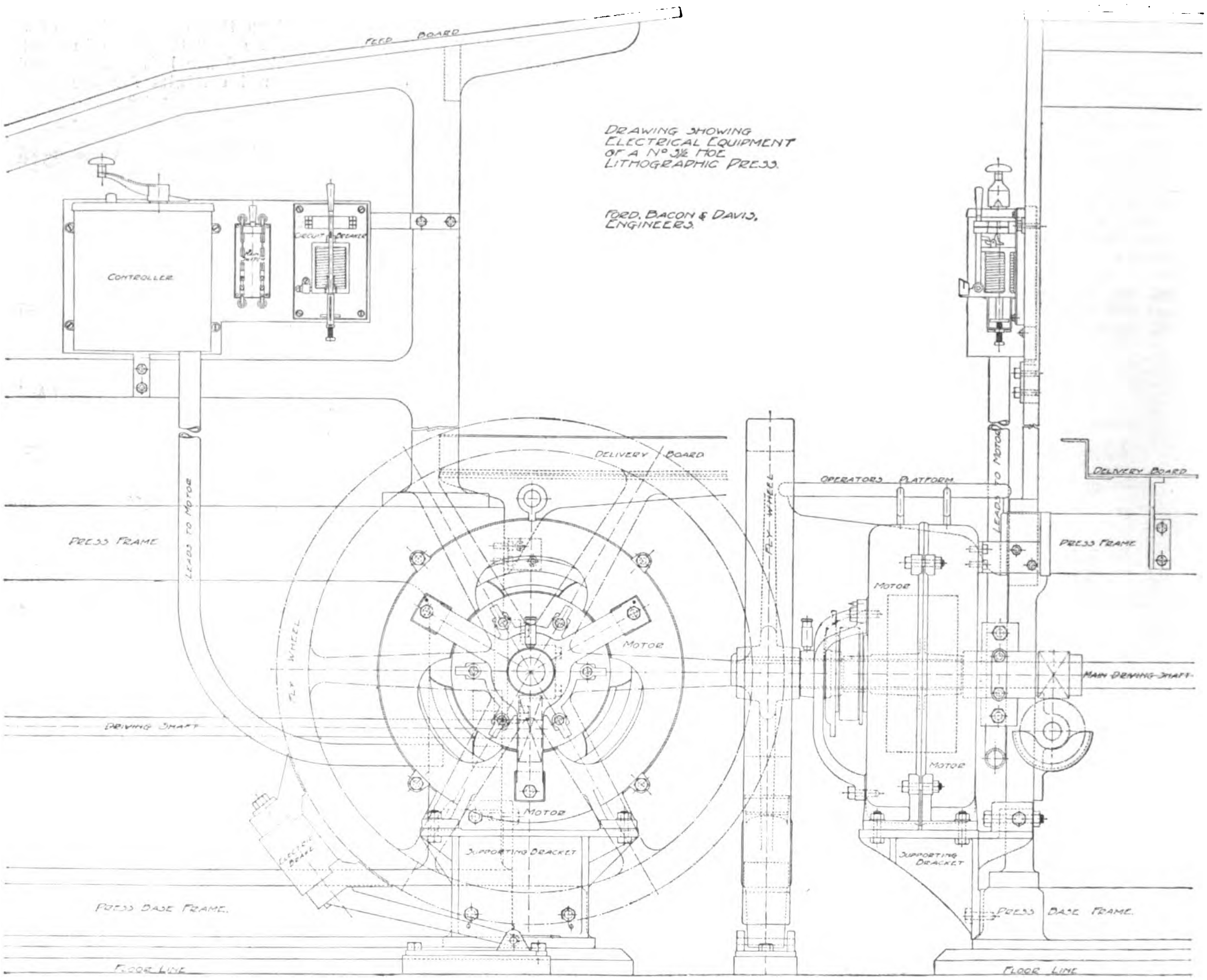
As a matter of fact there are two distinct systems of wiring, and either wing of the building could be disabled or detached without interfering with the other wing. Each system is again subdivided for light and power, and thus we have, as will be noted, four sets of conduit running from the board. The conduit throughout is steel or iron armored, even telephone and signal wires running with that protection. The conduit was furnished and installed by the Interior Conduit and Insulation Company, while the wire and cable used is Habirshaw red core, rubber covered, one conductor to each tube, and sizes larger than No. 6 being stranded. The whole wiring construction throughout the building, including the installation of the interior conduit was done by the New York Electric Equipment Company. A very complete and admirable system of wiring has been adopted. For each wing on every floor, except the first, the wires proceed to and from a center of distribution situated within a carefully designed wireway or recess in the walls all the way up the buildings. The recess is five feet wide across the face, and is from four to eight inches deep, allowing at all points 50 per cent. reserve space. This recess, fitted with cast-iron fire stops for the conduits at several stages, is cased in crimped iron, with stout glass doors for access, and each "center" has iron framework upon which in turn is mounted the panel board of slate supplying the floor. Slate sides make

this into a box about two feet six inches wide, four feet high and about four inches deep. The box holds all the small bus-bars, switches and fuses for light and power circuits on the floor. In this way the entire wiring system has been made entirely fireproof and of the most permanent and mechanical construction, while always readily accessible. The layout for the feeder distribution is shown on .the isometric sketch, the feeders for lighting being shown dotted and the power feeders by full lines. There is a separate power feeder for each wing of each floor upon which power machinery is used, while for lighting there is a separate feeder in each wing for the first and second floors, and above this, for each two or three floors as shown. A separate feeder is run in the elevator shaft for lighting the elevator halls and stairways. There are no main centers of distribution on the first floor ,this being the floor which is rented by the company for stores. There is a separate sub-feeder circuit for each store, running from the basement centers to small panel boards placed in each store. Usually the store circuits are furnished with current from the Edison Illuminating Company's street mains by a service connection to special double throw switches placed upon the basement panel boards. By throwing these switches the store circuits can be changed from the Edison service to the building service at any time, and the three-wire system of the branch store circuits changed to the two-wire system used throughout the building.

The lighting feeders are figured out for not more than three volts drop at maximum load and the power feeders for not more than four, and these conditions are well realized in practice, the drop for average load being but a small percentage of this.

From the centers of distribution within the wireway closets on the wall run the branch circuits, each controlled by a double pole knife blade switch. These branches are almost universally carried in exposed steel armored conduit, supported by small iron toggles from the tile arches, and the appearance is anything but displeasing, so rectilinear are the straight runs, so gracefully curved the elbows, and so clear the range of view every way along each ceiling and floor. At the point of entrance to the wireway the steel conduit on the ceiling is joined to a special multiple corner insulating box of cast iron supported by the iron framework of the wireway, and of such size as to permit 50 per cent. more branch circuits, the holes for the entrance of these future circuits being closed with small iron caps. The power branch circuits, where the motor is on the floor of the room, instead of running on the ceiling of the room and dropping down to the motor, are run down through the wire-way from the panel board to the ceiling corner box of the next room below, from which point they run on the ceiling to a position directly under the motor and then come up through the floor to the motor; the motor outlet box in this case being on the ceiling of the room below. Branch circuits to motors suspended on the ceiling run to outlet boxes on the ceiling located at the column nearest to the motor, the controlling apparatus for ceiling motors being placed on the nearest column or wall, as shown in one of the illustrations. Special insulating iron outlet boxes are used for motor circuits of sufficient size to include a porcelain cut out of the required capacity.

The branch circuits for lights terminate in cast iron insulating outlet boxes, which in the case of heavy fixtures and arc lamps, are supported by pipe hangers running up through the tiling and secured by washers. As it was, in many cases, impossible to arrange the lighting of the rooms until the machinery



SIDE ELEVATION. END ELEVATION.

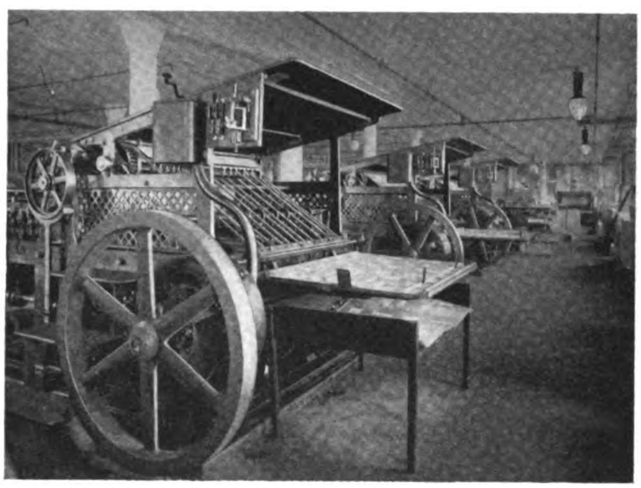
DIAGRAMMATIC VIEW OF LITHOGRAPHIC PRESS, WITH DIRECT CONNECTED LUNDELL MOTOR.

had been placed, the five light outlet boxes on the upper floors are supplied with two branch outlet openings for future extension of branch circuits, these, when not in use, being closed with iron caps. The one light outlet boxes throughout the building are provided with special covers, the receptacle boxes have a socket bushed through the cover and the pendant boxes having rubber bushings for the outlet of the flexible cord. There are about 2,100 outlets for lights throughout the building and 150 outlets for motors.

In addition to the switches controlling the branch lighting circuits upon the panel boards, certain classes of lighting outlets are controlled independently. Upon the third and fourth floors, which are used for the storage of labels and lithographic stones in racks, the aisles between the racks are lighted by rows of incandescent lamps, each aisle being separately controlled by a Cutter flush switch with iron wall box fastened to the end of the rack, so that each row of lights is used only when the workman is searching for a particular label or stone.

APPLICATIONS OF POWER.

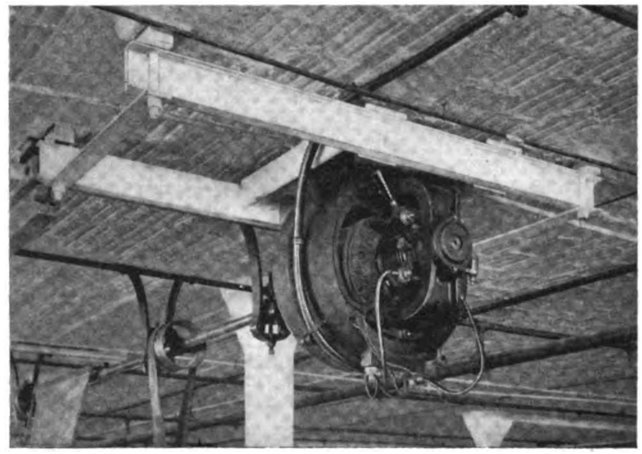
When we state that the building contains 141 power motors of a total of 847 h. p., it will be seen that here is a resort to electric driving of striking proportions. Over 100 of these motors are direct connected to lithographic and large type presses. The old plants of the company were often operated with a loss in line shaft and belt of 60 per cent. of the full power indicated by the engine when carrying all the machinery loaded; while in slack hours, the transmission loss would reach 75 per cent. Moreover, there was the dust and dirt, the obscuration of light by flapping belts and the risk of fire from belt holes in walls and ceilings. In resorting to electric power.



View of Direct Connected Lithographic Presses with Lundell Motors; Also Method of Enclosed Arc Illumination.

it was determined to install no motor of less than 2 h. p., and to group small machinery in blocks of four or five to be run by one motor direct coupled to a short line shaft, thus getting as nearly as might be the benefits of direct connection. The larger motors run up as high as 35 h. p. Various illustrations herewith show the methods of locating the motors and their relation to the driven machinery. The motors throughout are the well known Lundell slow speed type, made by the Interior Conduit and Insulation Co.

The lithographic press motors are of the series wound iron-clad type, disc-like and narrow, so that they can be placed directly on the extension of the main driving shaft of the press between the flywheel and the press frame. The mechanical design of the handsome motors is such as to make them simple, strong and durable in every part and easily accessible for any purpose. They are supported upon heavy cast-iron brackets, securely bolted to the frame of the press and the upper part of the motor frame is also attached to the press by means of a heavy iron strap. In order to regulate more closely the variation of speed of these lithographic presses, extra heavy flywheels are used. A special electric brake, consisting of a solenoid magnet, acts upon the periphery of these flywheels, near the floor. The controlling apparatus for these equipments consists of a main double pole knife blade switch, with fuses, a Cutter automatic circuit breaker and a special cylinder controller, like a dumpy street car controller, enclosed in an iron case and operated by a short lever with pointer. Upon the lithographic press equipments, five speeds can be obtained, so that the output can be varied from 660 to 1,140 impressions per hour. A motion of the controller lever automatically sets the electric brake, stopping the press very quickly, and a movement to another notch causes the press to reverse at a slow speed. The variation in speed is accomplished solely by commutating the field of the motor. The ab-

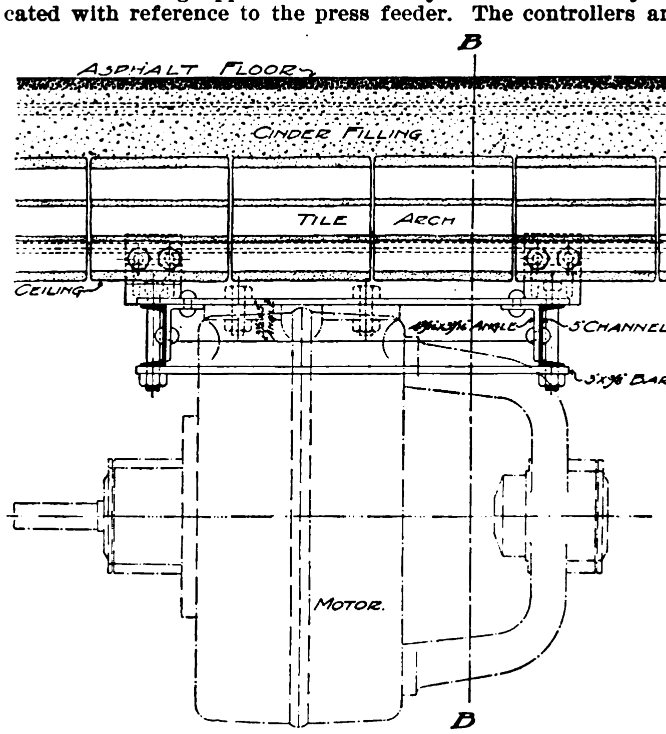


Lundell Motor Overhead, Driving Line Shaft.

solute control of the speed and movement of presses obtained by electric control is considered by printers as one of the greatest improvements that have been made upon printing machinery in the last few years, saving both time and annoyance over the old method of shifting belts, foot brakes and backing up by tugging on the flywheel. The wiring connections between the motor, the controller and the electric brake are carefully insulated and neatly run, as shown, in one line of iron armored conduit, so that every part of these equipments is entirely protected from mechanical injury.

The large type presses consist of two revolution, stop cylinder, rotary and perfecting presses of many sizes, driven by motors direct connected either by cast-iron brackets, or by means of cast-iron pedestals resting upon the floor and bolted to the main press frame.

The controlling apparatus is in every case conveniently located with reference to the press feeder. The controllers are



SECTION A-A.

Diagram of Method of Suspension For a Ceiling Motor.
(From the designs of Ford, Bacon & Davis, Engineers).

designed for obtaining the same number of variations in speed as with the lithographic presses by means of commutated field control, and also for obtaining reversal and electric braking. In the case of a rotary press, it can be stopped, in addition to

the movement of the controller, by means of several push buttons conveniently located at the delivery end of the press. These push buttons operate a secondary circuit, auxiliary circuit breaker and electric brake, so that by pushing any button the main circuit is opened and the electric brake applied. The sizes of the type press motor equipments vary from 2 to 10 h. p. with variations of speed to meet the actual operating conditions imposed by each different kind of equipment. The 32 small Gordon and Allen job presses are belted to short line shafts, which are driven by ceiling motors direct coupled to them.

CEILING MOTORS.

So far we have been considering chiefly motors built into the presses and driving the machine direct connected. The numerous ceiling motors are, however, equally interesting. They are all slow speed, as the shafting to which they are coupled runs at moderate speed, varying from 100 to 500 revolutions per minute. The motors are suspended from a framework of special channel and angle iron shapes secured to the steel girders and beams of the building by special beam clamps. Each motor has its own independent bearings, so that it is independent of shafting hangers, the motor shaft being coupled to the line shaft by means of a special adjusting Brown coupling. All of the ceiling motors are shunt wound and with but few exceptions run at one speed without reverse. The controlling apparatus consists of a double pole knife blade main switch and fuse cut-out, a Cutter automatic circuit breaker and a Cutler-Hammer automatic underload starting box. The wiring between ceiling cut-out boxes and controlling apparatus and between controlling apparatus and motor is all in steel armored Interior Conduit.

PLAN OF THE SIXTH FLOOR, AM. LITHO. BUILDING, SHOWING ARRANGEMENT OF LITHOGRAPHIC PRESSES, LOCATION OF THE LAMPS, ETC.
(From the designs of Ford, Bacon & Davis, Engineers).

MISCELLANEOUS POWER.

In one or two of the applications very slow speed is required, as for example in burnishing and calendering. Here spur or special worm gearing is resorted to. In these, as in all other classes of printing trade work, the great regularity of electric power running is found to conduce greatly to the evenness and excellence of the product.

The plant also includes eight electric elevators, in two banks of four each, installed by the McAdams & Cartwright Elevator Co., with Keystone electric motors. Two of these elevators are for passenger purposes. The six freight elevators will carry a load of 4,000 pounds at a speed of 150 feet per minute, and have well nigh double that capacity. The passenger elevators will easily make 250 feet a minute with 3,000 pounds. The elevator machines are of drum type duplex worm and spur gearing connecting the motors to the hoisting drums. The elevator machinery is located in a special compartment, with a board and attendant, and each elevator motor is protected by a Cutter automatic underload and overload circuit breaker.

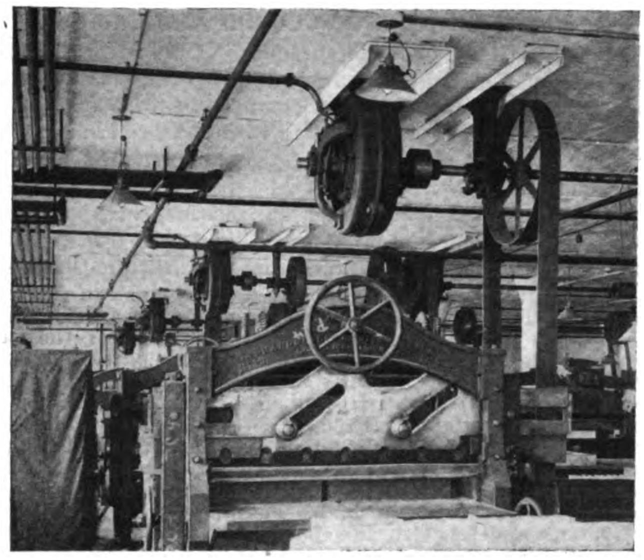
THE LIGHTING SYSTEM.

Reference has been made from time to time in this article to the features of lighting and of lighting circuit distribution, but emphasis must be laid on the fact that the plant is certainly one of the best exemplifications of interior arc lighting to be found in the world. All the working floors are brilliantly white, and the enclosed Bergmann arcs of the General Incandescent Arc Light Co. shed floods of serene light everywhere. It must be remembered that a great bulk of color printing is done in this establishment, and it is accordingly of the utmost importance that colors shall blend, match, harmonize or contrast in their proper values. Hence ink mixers and pressmen who would be working at a great disadvantage with gas or incandescent lamps, can hit the mark just as unfailingly at midnight as at high noon, thanks to the beams of the arcs used. No stint of light is allowed, for on one floor we noted no fewer than 28 enclosed arcs lighting 30 lithographic presses. The effect was simply superb. The Bergmann lamps are burned with opalescent inner and outer globes. As will be noted, where necessary for detail and other work, single and cluster incandescent lamps are also provided. The offices of the company have appropriately handsome fixtures, and the art gallery is devoid of fixtures, the lamps being all concealed in a cove moulding. The fixtures and all the arc lamps were installed by the General Incandescent Arc Light Co.

ECONOMY OBTAINED.

A plant so well designed and carried out should yield notable economies, and the subjoined data of tests taken and furnished us by Ford, Bacon & Davis, are well worthy of study. The total capacity of the engines is 660 h. p., of generators 440 k. w., and the rated capacity of all the motors installed is 847 h. p. There are 3,000 incandescent lamps and 140 arc lamps connected. During six months of operation the

average electrical load at the switchboard has been approximately 200 h. p. and the maximum load at the switchboard has been 2,400 amperes at 115 volts, or 370 h. p. Thus the average load upon the plant is 17.6 per cent. of the total rated capacity of motors and lamps connected, while the maximum load is 32.7 per cent. For the same period of six months from the daily records of power produced, as recorded by the switchboard wattmeters, together with records of weighings of the amount of coal burned, it is found that each electrical horse power hour at the switchboard has been produced by 4.45 pounds of coal. This includes the coal used for starting fires, banking fires over nights, Sundays and holidays, and also includes the running of the small high speed unit for night work at an efficiency considerably less than the large Corliss engine units. Considering alone the operation of the large Corliss engine units in their daily 10 hour runs, during this same period, they show an economy of 3.25 pounds of coal per



LINE OF PAPER CUTTERS DRIVEN BY LINE OF LUNDELL CEILING MOTORS.

electrical horse power hour at the switchboard. The coal used is anthracite buckwheat.

Careful comparisons have been made as to the cost of light and power in the new building as compared with the same period of former years. These figures include, for the present plant, the cost of fuel, wages of engineers, firemen and electricians, engineers' supplies and gas bills. The figures for the same period of last year include cost of fuel, rented power, wages of engineers and firemen, engineers' supplies, and gas and electric light bills. Including all of these items, the cost of power and light in this new building per unit of manufactured product is 55.8 per cent. of the previous cost, or a saving of 44.2 per cent. With this marked economy have gone many incidental advantages already hinted at, such as convenience, comfort, greater coolness in summer, better health of employés, and a decided gain in the quantity and quality of the work, especially that of an artistic nature.

A MOVE TOWARD STANDARD ELECTRICAL DIAGRAMS.

The Chicago Electrical Association has taken up and is pushing a very commendable work in the way of compiling and perfecting a set of standard conventional diagrams for use in electrical engineering drawings. There are at present a few conventional figures which electrical draughtsmen have tacitly agreed upon as representing certain pieces of electrical apparatus. For example no one in this day and generation thinks of drawing out a dynamo in full either in a patent specification or a wiring diagram. Nevertheless there are plenty of electrical mechanisms that are represented in a variety of cumbersome ways by various draughtsmen, and it is most desirable that some easily made, expressive symbol or diagram be devised and put in general use. It was with the idea of helping on this good work and aiding in the establishment of standards that a committee was appointed by the Chicago Electrical Association last year. This committee has been steadily at work ever since collecting the opinions and suggestions of electrical draughtsmen, sifting out and choosing the best forms and it is expected before long to put out in pamphlet form a collection of recommended diagrams. The U. S. Patent Office authorities have expressed great sympathy with the work, and other electrical engineers will certainly do so when they are acquainted with its aims. It is hoped to present the first fruits of this movement to the electrical fraternity within the next few months.

TELEPHONY AND TELEGRAPHY

"SPARK TELEGRAPHY" IN GERMANY.

Prof. Slaby delivered a lecture on "Spark Telegraphy" before the German Society for the Advancement of Industry, on November 1. In the first instance he objected to the terms "telegraphy without wires," "radiator" and "coherer"—to the latter two because they were words of foreign origin. He used "spark-telegraphy" as the title of his lecture, and proposed the "good German words" Strahlapparat (ray apparatus) for radiator, and Fritter or Frittröhre for coherer. Prof. Slaby then described large-scale experiments he had made himself near Potsdam over distances of from one to two miles, and others over a distance of 13 miles between Schöneberg and Rangsdorp. From his systematic experiments he found that obstacles such as trees, buildings and hills considerably hinder the propagation of the waves, and are especially disturbing when in the neighborhood of the transmitter or receiver. Contrary to Capt. J. N. C. Kennedy's experience, the Professor finds that the length of the wires at the terminal stations is all-important, and that the height to which they are led is, within certain limits, of secondary importance. The lecturer stated that he had found that the dust in the air also tended to impede transmission, for whereas on the English coast signals were transmitted over distances 200 times as great as the length of the charged wire and at Spezia 500 times, this figure only reached 70 to 100 in dusty Brandenburg. Prof. Slaby also found that he obtained better results if, instead of Marconi's fairly thick wire, ending in a flat sheet or cylinder of copper, he used quite thin insulated wire of low electrostatic capacity, ending quite freely in the air. In the 13-mile transmission above referred to, a 4 mm. wire with thick cotton insulation and 330 yards long, attached to a captive balloon, was successfully employed after unsuccessful trials had been made with a two-wire telephone cable of the same length. Prof. Slaby also mentioned the disturbing influence of atmospheric electricity. Finally, he stated that wires running in the same direction as the waves very considerably increase the possible distance of transmission, and he showed an experiment in which he used the same wire for simultaneous wave and current telegraphy.

TAKING NEW YORK TELEPHONE WIRES OFF THE ROOFS.

The New York Telephone Company, having succeeded in getting all its downtown wires out of sight, is now trying to accomplish the same result in the residence districts. The uptown wires are strung along the roofs of houses, small wires running from the main line into the houses that have telephones. It is now proposed to take the wires off the roofs and run them along the back fences of the houses. In this way a whole block can be fed from the one cable.

The uptown districts are fed from the telephone wires in the subways. At the corner of each block where there are telephones the subway wire is tapped by a line which runs along the roofs of all the houses on that block. It would be costly to tap the subway for each residence telephone, or to run the subways through all the cross streets.

It has required weeks of diligent canvassing to get the consents of property owners to the roof wire system. People who didn't use telephones couldn't see any reason why they should lend their roofs. Others were afraid of fire from a crossing of the wires. Still others didn't want linemen walking across their roofs at all hours of the night and day, or were nervous about the chance of thieves gaining admittance to their houses on the pretence that they were line repairers. All of these objections were overcome in time, however, and the company succeeded in establishing a very complete system of roof wires in the residence sections of the city.

Now the telephone people have concluded that it will be

better for all concerned to take the wires from the roofs and string them along the back fences uptown. The wires will be incased in lead and painted the same color as the fences. Property owners have very generally fallen in with the scheme. Most of them are glad to get the wires off of the roofs.

In the downtown business district 10,000 subscribers are served without a wire being visible.

SEVEN OPPOSITION TELEPHONE COMPANIES IN INDIANAPOLIS.

A special dispatch from Indianapolis of recent date says: Seven independent telephone companies operating in this State, all of them fighting the Bell system, are uniting to put an independent plant in this city, the details of which will be perfected very shortly. These companies include the Kurtz, of this city; the Harrison, of Lafayette; the Cushman, of Laporte; the Gillette, of Michigan City; the Kokomo, of Kokomo; the Bears, of Ft. Wayne, and the Chicago and South Bend Company, of South Bend.

These companies claim to control 168 towns in the State, and they will attempt to operate in this city under a franchise granted to the Citizens' Co-operative Company in 1886. The co-operative company attempted to string wires at that time, but were stopped by injunction, hence the claim that the franchise still holds good.

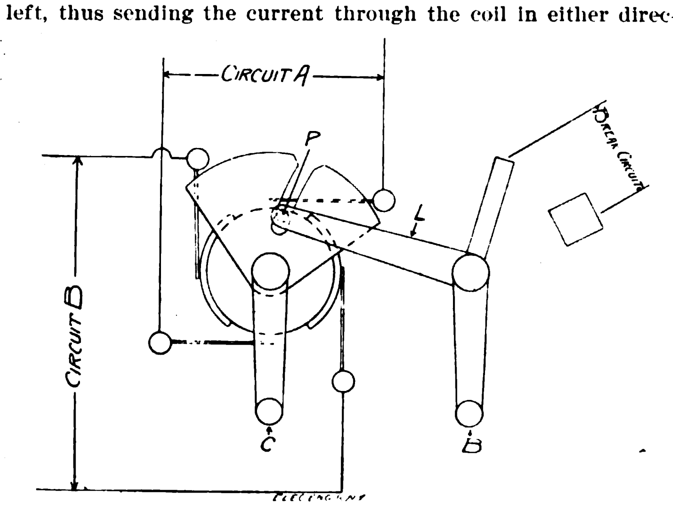
The scheme above referred to does not appear to be moving along very rapidly.

SWITCHES FOR X-RAY WORK.

BY ELMER G. WILLYOUNG.

I HAVE just noticed the article in The Engineer of December 9 by Dr. F. S. Kolle on "The Kolle Double Current Switch for X-Ray Work." This switch is intended to accomplish the same purpose as is accomplished by the "Interlocking" switches, which have been used on all the separate break X-ray machines made by my firm since early in November, 1896. The scheme of the first type of interlocking switch is shown in the accompanying sketch.

Switch B can move only one way, and closes the "break" circuit, and until it is closed the coil circuit switch is locked by the pin P (attached to arm L, which itself is attached to B). When B is closed, then C may be moved either to right or left, thus sending the current through the coil in either direction. This Dr. Kolle's switch will not do. With switch C closed either way it is obviously impossible to throw off the break circuit.



WILLYOUNG X-RAY INTERLOCKING CIRCUIT BREAKER.

We now have a much neater form of interlocking switch, but the diagram is too complex for easy reproduction here. Suffice it to say that the break circuit is closed by drawing forward the handle of the switch; it may then be thrown to right or left to close the coil circuit in one direction or the other. But the handle cannot, now, be thrown back.

The break, be it vibrator or motor, will not always start off promptly upon closure of the break circuit. Until it has so started up and reached its normal speed, an excess of current will pass through the coil on closure of the coil circuit. In Dr. Kolle's switch there is danger of closing both circuits too nearly together. The inability to reverse is, however, probably the most serious weakness.

SOME POINTS ON ENCLOSED ARC LAMPS.

THE latest issue of the Transactions of the American Institute of Electrical Engineers contains the discussion on the paper of Messrs. Freedman, Burroughs and Rapaport on "Efficiency and Life of Carbons in Enclosed Arc Lamps." We give below an abstract of the interesting remarks made by Mr. Louis B. Marks:

The authors give a curve for the relation between voltage across the arc and length of arc. While it is true that this curve is of some value in representing the ratio alluded to, still I hardly think that it would be safe to use a curve of this kind as a basis for any important measurements, because it seems to me that that curve is really one expression of the ratio between the voltage and length of arc of this particular lamp. This ratio varies very greatly in different lamps and in fact even in the same lamp. If you take two cored carbons, for instance, you will find that the ratio varies. You will also find that a figure such as 83 volts corresponding to the length of .023 of an inch, as given, may not apply. It may be 20 or 25 per cent. off. Again the ratio will naturally depend on the position of the arc in the bulb. The authors do not give the conditions under which this particular test was made, and without these conditions the tests lose much of their value.

There is a very interesting point in the paper which the authors have not gone into very fully—perhaps one of the most interesting points in connection with the enclosed arc, and that is the voltage at which an enclosed arc can be safely and steadily run as compared with the voltage of the mains at which such an arc can be run. The nature of their tests is very much the same as those of Professor Thomson, which were recorded in a paper read by him at the convention of the National Electric Light Association at Niagara in June. Their results are, however, somewhat different than his, and I may say that the results of Professor Thomson, and those given in this paper, are quite different from my own. Take Blondel's measurements made in Paris and you find these are different, and some recent measurements of one of Dr. Nichols' students at Cornell are also different.

With regard to the remarks made by the authors of the paper, that while they claim that an arc cannot be run steadily below a certain voltage of the mains, which I believe they figure here about 95 or so, this is hardly true, and will depend on conditions. I presume they took the commercial lamps in the market; they used the ordinary bulb, and so on; but if you vary these conditions, that is, change the diameter of your carbon and the amount of current, change the size and perhaps the shape of the bulb and the position of the arc in the bulb, and the nature of the gas checking devices and the quality of the carbon, etc., you will find probably that an arc may be run at a voltage which is very close to that of the mains under some conditions; so that the broad statement that an arc run on mains that are below 95 volts is unsteady, would hardly be true.

The authors say: "The size of the enclosing globe affects the life, it being less by a slight amount for a smaller globe. All the other conditions being the same, a lamp having a smaller globe will, during a given run, have its globe replenished with air from the outside oftener than if it had a larger globe."

I think that that statement is open to question. Anybody who has experimented with various sizes of enclosing bulbs will have found that there is quite a marked difference in favor of the smaller bulb; that is, with a smaller bulb, under ordinary conditions, the life per inch of carbon is greater. True enough, we do not get the total life of 100 or 150 hours, because there is not sufficient carbon; but the life per inch of carbon consumed is ordinarily greater, in some cases considerably greater, with the smaller bulb. Naturally in changing the size of the bulb, in order to get the best results, it is

necessary to change other conditions—to change the gas checking effects, for instance, whatever they may be. But I believe that, generally speaking, the life of a carbon is increased, or the consumption of carbon per unit time is decreased with decrease in the size of the enclosing bulb.

In most lamps, as is stated in the paper, the relative life of the positive and negative carbons respectively changes as the arc descends in the bulb. Now here is an apparent exception to the rule. The average ratio is about 1 to 2½ or 3, I believe. My own measurements are a little different from that—perhaps 1 to 4; but I find a case 1 to 10. That would be accounted for in several ways. If the voltage of the arc decreases, the ratio naturally increases, and at a certain voltage of the arc and a certain current, it is possible to increase the ratio so greatly as to approach infinity. That is, instead of having a ratio of 1 to 2 or 3, or 1 to 10, you may go up to 1 to 20 or 1 to 50, or more, depending on the voltage of the arc and the current passing at the time.

Regarding the photometric tests, I think we have spent a great deal of time in photometric measurements, and it seems to me that to a certain extent it is time wasted. With the enclosed arc, the character of the light, that is, the quality of the light is quite different from that of the standard adopted in order to make the measurements comparable with others, and I think in some cases the relative measurements of candle power would be meaningless.

The conclusions drawn by the writers seem to cover almost all the advantages of the enclosed arc lamp. There is perhaps one point of some importance which the authors have neglected to allude to, and that is the ability to run these lamps singly on an incandescent circuit. They refer to that in the paper, but in summing up the advantages of the enclosed arc over the open arc lamp, they have accidentally omitted this point.

TWO THOUSAND VOLT TRANSMISSION AT ENGLEWOOD, CHICAGO.

THE Englewood Electric Light Co., at Chicago, employs what may be called a 2,000-volt transmission in connection with its system of feeders. This company distributes the bulk of its incandescent current at the usual voltage employed in older alternating plants, viz., 1,000 volts. On one of its northern feeders it found its business increasing to such an extent at a distance of four to five miles from the central station that it became evident that either more copper must be put into feeders, or the voltage of transmission must be raised. To raise the voltage by putting in a 2,000-volt alternator at the power house and changing all the 1,000-volt transformers on the feeders would have been an expensive way out of the difficulty, to say nothing of the disadvantage of having a machine in the station suited only to supplying one feeder.

The plan which has been adopted is very simple and interferes in no way with the flexibility of the station outfit. It consists in putting step-up transformers at the power house which transform the 1,000-volt primary current there to 2,000 volts. This 2,000-volt current is then transmitted over the long feeder to a center of distribution four miles away, where it is transformed down to 1,000 volts and fed into the regular 1,000-volt mains for distribution over the district. The scheme is a very good one for plants where the interest on the investment in additional feeders would amount to more than the interest on the step-up and step-down transformers plus the cost of the power lost in the double transformation, and further shows the beautiful adaptability of the alternating current to everyday requirements.

MUNICIPAL AFFAIRS

SHORTCOMINGS OF THE EASTON, PA., MUNICIPAL PLANT.

A statement was made at the last meeting of the department of water and light of the city councils, that surely does not speak well for the city electric light station nor for its management. The remark came out in connection with the request on the part of persons living up the Delaware road that the city should extend its line and furnish lights along that thoroughfare, which is known to be especially dark and dangerous at night. The Edison Illuminating Co. has a line along that road and it was the opinion of some that it would be cheaper to pay that company for furnishing lights than for the city to do the same service. The city established its own plant and is maintaining it at the present time under the belief that it can furnish the lights for the streets at a lower price than it would have to pay to have the work done by others. In fact there is no reason why it should not be able to do so. If it were necessary to pay a private company a certain price per light, it would mean that the city would not only pay just what each of those lights cost the company, but also a margin of profit. The city has spent considerable money in establishing an electric light plant and there are constant calls for funds to improve the service. Under such circumstances the people of the city have a right to expect that lights could be furnished at as low a price as they cost the Edison Company, while the profit that the private company would make, should be that much gained by the municipality. If this is not the case in practice, it means that the municipal plant is not conducted with the same degree of efficiency and economy that the private plant is and it is but natural to look to the management of the city concern for an explanation of the fact.

So much has come to public notice concerning the city electric light plant of late days that it surely does not create admiration as a shining example of municipal ownership.—Easton Argus.

FIGURES ON PROPOSED MUNICIPAL PLANT FOR HOLYOKE, MASS.

The Holyoke Water Power Co. has come forward with a statement about the cost of electric lighting if the city owns a plant, and the company's side of the case is presented by the treasurer, Edward S. Waters. He figures the cost to the city at $40 a horse power, and with the expenses that he considers necessary to run the plant, the annual tax would be $30,475, not including oil or waste. He states that this is $5,475 more than the city is paying to-day. He allows for a 5 per cent. depreciation item to be set aside every year in his figures and for a sinking fund for 10-year bonds. He states that any surplus that might accrue would not be used to lessen taxes, but that they would constantly grow. Mr. Waters says further that if his company had allowed that its power cost $25 a year, the net profits on the business done for the city would have been less than 6 per cent. on the actual cost of the plant. In the opinion of the Holyoke Water Power Co. the city does not want the public ownership of a lighting plant.

PROTECTION OF WATER COMPANIES IN WISCONSIN.

Because of the contention in the West against corporations and in favor of municipal control of what are regarded as public necessities, the private water companies in several States contemplate an organization for mutual protection. Such an association is in existence in Wisconsin, where twenty or more private water companies have banded together. It is the intention now to broaden this organization to take in the private water companies in Illinois, Indiana, Michigan, and Iowa. Representatives of over 150 of such companies have been invited to attend a conference, on a date not yet named, in Chicago. A promoter of the organization says that one of its purposes will be to furnish means to fight in the courts the efforts of city councils to reduce rates agreed on by city franchise and contract to what, it is claimed, would be a ruinous point so far as profits and the ability to pay interest on the millions of bonds are concerned. The defeat of any one company is regarded as a threat to all of them, and hence the purpose to organize.

EVILS OF PUBLIC OWNERSHIP.

There is much talk nowadays of public ownership of everything, from gas and water to street cars, telegraphs, and telephones. In theory this is no doubt very pretty, but in practice we have an idea that, under present conditions, at least, it would prove to be expensive and even dangerous.

If our municipal corporations were as well managed as they should be, if the political machines were already as effectually smashed as in good time they will be, then the public ownership of all these semi-public properties might be very well, indeed. But at present we have much more property publicly administered than can be looked after with either economy or skill.

As a general thing the streets in American cities are badly paved, badly drained, and badly cleaned. On the other hand, the street cars, the street lights, and the telephones—all generally under private management—are usually very good.

In this country the general government and the municipalities as well have bitten off quite as much as they can comfortably masticate.—Leslie's Weekly.

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1897—A RETROSPECT.

THE dawn of a new year usually brings with it resolutions for better work, and not infrequently regrets for the year about to close. We feel certain, however, that few engaged in electrical work will harbor the latter sentiment. Indeed, far from engendering pessimism, the year 1897, while not standing forth as one of particular mark in electrical science or invention, has nevertheless earned an honorable mention in electrical annals. And more particularly has this been the case in our own country, in which electrical enterprises of all kinds perhaps more than others have shown their inherent vitality in the rapid recovery from the recent years of business stagnation. Leaving business aside, however, the world's stock of electrical knowledge has also been enriched and the economy of wealth increased by the applications directly resulting from that knowledge.

Perhaps the greatest direct agent working toward this end has been the electric motor and all that the term includes. Electric power transmission has made a marked advance in 1897. In whatever direction one glances, notable strides have been recorded during the year. The Frankfort-Lauffen experimental transmission over a distance of 107 miles has during the year been very closely approached by a prospective transmission of 75 miles at 30,000 volts in California. Niagara has witnessed an increase of nearly double its power utilization during the year, while during the same period the great 75,000 h. p. electric plant at Massena, N. Y., has been begun in good earnest. Europe has also done its share in transmission work. There, as well as here, the three-phase system of transmission has obtained a still firmer footing than ever, so much so, indeed, that there can now be little doubt as to the future of that system. As regards local power transmission and motor work, no one year in electrical history has a like record of progress to show. Even the old-school mechanical engineers who have all along stuck doggedly to the ancient belt are beginning to desert their old love, and the electric motor has been the subject of discussion at more than one meeting of the leading mechanical engineering societies of the world. It has filled many of our columns to give even a bare mention of such installations carried out during the year, but we cannot forbear pointing again to such significant instances as the Government Printing Office, the Mergenthaler plant and now the new establishment of the American Lithographic Co., described in this issue. No less than 140 motors of various sizes furnish power to the presses and other machinery in this magnificent and beautifully equipped lithographic plant.

The electric railway has not lagged behind during the year. In Europe, especially, the scepticism of the past has given way to an enthusiasm rarely met with in that conservative quarter of the globe. Germany particularly has gone in for electric railway work with a vengeance, and has a long list of new roads to show for the year. Even England has awakened at last, giving our electrical factories some pretty fat orders. Nor has America herself stood still. Notable advances have been made in the extension of interurban railway lines on the old trolley system, and if the city railway systems have not increased in the same ratio it is simply because there was little territory which had not been already occupied. Still we may record one notable piece of city work in the practical wiping out of the main horse car lines in New York and their conversion to the electric conduit system. We cannot but believe that New York's example will be followed eventually by other large cities, if on no other score than that of operating economy and reliability. The third rail system has obtained a firmer foothold than ever on steam roads and this year has furnished figures of cost of operation which are startling to say the least, and which appear to make it almost absolutely certain that the short haul traffic of the future must be accomplished by this method. How soon the long haul traffic will follow on the same lines is a question which railroad managers themselves are anxiously debating. The electric cab, as a means of transportation, has everywhere made decided progress. New York's venture has led to an order for 100 additional cabs, which are now building, while London's electric cab service, introduced during the year, met with immediate success. The electric launch also has gained in numbers and appreciation. Certain it is that America may well claim to have held its own, when the Czar of Russia turns to us for one craft of this kind for his own use, while another goes to South Africa.

In spite of the improvements in gas lighting the electric light has more than held its own, particularly in the larger centers of population. The enclosed arc on low tension circuits has more firmly established its claim to recognition and confirmed the judgment of its early advocates. As to the newer proposed systems, the vacuum tube light in the hands of Mr. Moore has made substantial progress and we are promised still further developments in the not distant future.

In central station work we can signalize the strong tendency toward the use of the storage battery, evidenced by its adoption in several large lighting and railway stations. Nor must we omit to mention the radical departure in central station practice inaugurated by the Brooklyn Edison Co., in the adoption of the three-phase high tension system, with rotary transformer sub-stations. We feel certain that this practice will be extended to many old as well as new stations.

During the year electric communication of intelligence without wires has received its share of attention from Mr. Tesla and others. The most sensational, if not the most practical, method actually disclosed, has been the Marconi system of Hertz wave telegraphy. Certain it is that the results achieved have been remarkable and while we lack conclusive evidence

of the applicability of the system to general use over wide areas, there is little doubt that it will find more than one special application. Of the more commercial systems, Mr. Delany's machine method is worthy of special mention. The Roberson quadruplex introduced during the year has also shown itself to be a marked advance on the system hitherto employed.

The telephone's claim to mention in this retrospect is based more particularly on the increase in its use rather than on any special improvement or innovation in apparatus. The long distance lines have reached out further than ever and have brought Omaha within earshot of New York, a notable achievement indeed.

As to the X-ray, it would take several good-sized volumes to record the year's work in this fascinating and tantalizing field. The controversies as to the theory of the ray still continue, though with less virulence than formerly, but the applications of the ray in surgery, medicine, as well as in the laboratory of the analyst, continue with wonderful success and unanimity of purpose.

We might touch on a score of other applications, such as the electrolytic, the aluminum, and electric furnace industries generally, all of which have rising curves to show, but lack of space forbids. We cannot conclude, however, without alluding to the steady though slow progress in the work of getting electricity direct from coal. Borchers has during the year described a new coal gas cell of his own based on his previous work, while Prof. Short has entered the lists with an ingenious combined gas and electric generator. Mr. Case has also shed some further valuable light on the subject.

While we have had no new X-ray to give the year special éclat, a survey of the past twelve months' achievement is distinctly encouraging and full of promise for the coming year.

THE MALIGNED ELECTRIC CAB.

IT will be well remembered how bitterly and horribly the trolley was maligned in its younger days. No misrepresentation was too wild, no language was too strong, in regard to the demerits of the innovation; and the yellow journals literally frothed at the mouth as they bit at its flying wheels. The electric car has now outlived all that, and is admitted to be a respectable and useful member of society. The electric cab, however, appears to have stepped into its place as a recipient of abuse and as a theme around which to weave the improbable and impossible. That augurs well for its prompt success. Just as the early motormen helped a little bit by their rawness in earning a bad reputation for the trolley car, so the electrified cabmen by their shrewdness may have an important part to play. It is reported from London that a gentleman calling an electric cab the other day was greatly chagrined by being told by the driver, half way to his destination: "She's run down, sir," and to all appearance the batteries had no Happening to turn back a few minutes after, the passenger out, tendered full fare to the sorrowful Jehu and walked on. Happening to turn back a few minutes after the passenger was amazed to see cabby pick up another fare, inward bound, and starting off at a spanking pace.

This incident is brought to mind by a story that sparkled through the columns of several New York papers some days ago about an unfortunate bridal couple from Boston, who entrusted their fortunes to an electric cab. The driver could not manage his vehicle, which danced first on one wheel and then on another, stood on its tail and then on its head, and after sundry mysterious cavortings dumped the bridal couple out in the road with their baggage, all badly broken up. As there is only one electric cab service in New York, it would have been pretty easy to trace the accident to the right cab, but they had all showed up in splendid condition; and the manager was mystified. An inquiry was therefore started, and several facts soon appeared. No such bridal couple had been registered on the Boston train or at the hotel named. There was no house on the street with the number as given, as the point at which the accident happened; on the contrary it was an open lot. No electric cab accident had been noted by any of the inhabitants of the street, and the policeman on the beat said he had never seen an electric cab in that street, anyway. "An enemy hath done this thing," is the thought of the electric cab manager, who, being a charitable, broad-gauged man, is slow to accuse any livery stable proprietor of setting the story afloat. The trouble is that a stern chase being proverbially a long chase, the electric cab will be a long time overhauling that false and ridiculous yarn, but there is meantime some consolation in the knowledge that scores of new electric cabs and hansoms are now being added to the service in this city.

NEWS BY TROLLEY CAR.

THE distribution of news by means of the now ubiquitous trolley cars has already been attempted in various ways, and chiefly in the line of advertising, outside the car as well as inside. In some cases, enterprising stores have mounted their notices on the trolley poles, like sails or pennants. The idea has also been successfully carried out by putting little flags or signs on cars when the circus is in town or when the ice will bear in the parks. In some places, the cars in bad winter weather have carried signals notifying public school children as to whether school will be open or not. Of somewhat the same nature is the plan now being carried out on the Akron, Bedford & Cleveland suburban trolley line of displaying weather signals. The plan is for the local weather bureau to notify the road of the successive and prospective meteorological changes and for the cars as they go out to mount the appropriate signal in the shape of a tin flag symbol. Steam railroads have already tried this useful plan, and it is evident that the trolley cars can be even more efficient as distributors of such news quickly over large local areas. Cars running out into rural districts will be specially serviceable in this way.

MR. TESLA'S SUN MOTOR.

THE New York World of December 26 prints a story with an "illustration" of Mr. Nikola Tesla's latest work, consisting of an apparatus for generating steam by means of the heat of the sun's rays when available. According to the World Mr. Tesla is planning to build an immense plant on Long Island as soon as his model is perfected. In the center of a large room with a glass roof will be placed a huge cylinder of thick glass. This will repose on a bed of asbestos. A system of mirrors will reflect the rays of the sun into the glass cylinder full of chemically treated water and thus generate steam which will be led to a steam engine.

Mr. Tesla proposes to give his invention free to the world when it is worked out.

ELECTRIC TRANSPORTATION

ELECTRIC DELIVERY WAGONS IN CHICAGO.

THE electric vehicle is steadily gaining ground and is now entering into practical commercial work. Some account of the performance of the delivery wagons turned out by the American Electric Vehicle Co., of Chicago, will be of interest. Two wagons of the type shown in the accompanying engraving have now been running five months and have been put to the severest kind of a working test. They are the property of Chas. A. Stevens & Bros., silk merchants of Chicago, and are used for delivering goods.

The weight of each wagon is 1,700 pounds, of which 572 pounds is in the batteries. The odometer shows that each wagon has run an average of 37 miles each working day, or a total of 4,810 miles. Much of this has been made over exceedingly rough streets, as anyone acquainted with the decayed cedar block pavements of Chicago can testify.

Each wagon has one 3½ horse power motor of the American Electric Vehicle Co.'s design, dust and water proof. These are geared to the two rear hubs and a differential gear and hollow

ELECTRIC DELIVERY WAGON, CHICAGO.

armature shaft provide for the difference in rotation of the rear wheels in turning corners. The armature rotates at about 1,200 revolutions per minute when the carriage is at full speed on a level. The maximum speed is 12 miles an hour. The wheels are 34 inches in diameter, both front and rear, and have been equipped with 3-inch pneumatic single tube tires of very heavy design. These, however, are being changed to cushion tires 2½ inches in diameter, as it is found that the pneumatic tire gives out quickly in rough delivery work where the vehicle is pounded along over rough streets at full speed.

The batteries are the Crowdus type made by this company. Forty-four cells are used, each cell taking up 4¼x9x5¼ inches of space. They are, of course, completely enclosed with but a small vent for the escape of gases. The controller employed groups the batteries in three combinations to give three different speeds. On the first point four groups, eleven cells in series in each group, are put in multiple. On the second point two groups of 22 in series are put in multiple. On the third point all 44 cells are put in series to give full speed. The current required to maintain full speed on a level runs very close to 15 amperes, and, strange to say, this does not vary more than an ampere or two between granite block and smooth asphalt or macadam. The worst power consumer is a broken cedar block pavement full of holes, where the current sometimes runs as high as 20 amperes. The initial starting current is about 25 amperes.

The batteries are charged at night off the regular 110-volt current from the Edison mains. The charging current is started at 7 to 8 amperes, the 44 cells being of course in series, and toward the end of the charge reduced to 4 or 5 amperes. The company contracts to maintain the batteries at $50 per year, for a wagon of this kind, so that no fear need be entertained by purchasers as to excessive cost in that direction.

A few minutes calculation will show that an electric delivery wagon is by no means an expensive luxury. These delivery wagons, run by horses, would require six horses each to make 30 miles a day according to the regular calculations of the teaming companies doing business in Chciago. To make 37 miles a day therefore would require no less than eight horses. It is unnecessary to say that the electric vehicle, even where power is high, can be run for less than the expense of feeding, housing, shoeing and renewing eight horses in a large city. Supposing the charging current to cost $1 per day and the battery maintenance $50 per year (by contract) the cost for 310 working days would only be $360. This, of course, does not include attendance during hours of charging and general repairs. At the same time it must be remembered that the horses require more attendanec than the electrical apparatus. Furthermore, as matters are at present, the electric wagon with its illuminated sign is worth all it costs as an advertisement, even if it were worth nothing for delivery purposes. It is a good sign that the American Electric Vehicle Co. has numerous orders on hand and is about to get out some new types of vehicles to fill the demands of various classes of purchasers.

BOOSTER IN THE SOUTH CHICAGO CITY RAILWAY POWER HOUSE.

THE South Chicago City Railway during the past summer installed a booster at its power house on the Calumet river at South Chicago, Ill., for raising the voltage on some of its long feeder lines. Some time ago this company acquired control of the Hammond, Whiting & East Chicago Electric Railway, operating in a territory centering about eight miles south of the South Chicago power house. The two roads have been run in connection with each other for some time. The Hammond, Whiting & East Chicago lines had but few cars on them and were run from a power house located at East Chicago. It naturally became a question whether it would not be better to operate these lines from the South Chicago power house, using a booster to keep up the voltage, if necessary, when the travel was heaviest. The matter was investigated, and as a result the plan of feeding through a booster from South Chicago was adopted and the East Chicago plant has been shut down. The booster is not run when the traffic is light.

The great majority of boosters used in electric railway plants have been driven by an engine. At South Chicago, however, the two boosters are driven by a motor. This plan of running the boosters was adopted because the power house had already an abundance of engine and generator capacity and the greater part of the output of the station is generated by a large compound, condensing, direct connected unit, which is one of the most economical units of the kind in the country. It is, therefore, probable that it is more economical to use this cheaply generated electric power to drive the boosters rather than drive them with a small high speed engine of low economy, to say nothing of the greater convenience of the motor.

The motor is shunt wound and has a capacity of 100 kilowatts. Each side of the motor has directly coupled to it a booster, with a capacity of 400 amperes and at full load gives 125 volts, so that the full load voltage on the boosted feeders at the power house is 675. The boosters are, of course, series wound and have a German silver shunt around the fields with which the voltage is adjusted when they are first installed. They are the regular multipolar General Electric machines which, when compound wound, are used as 50 kilowatt lighting dynamos.

One of these boosters is used to supply the Hammond, Whiting & East Chicago lines and the other supplies the Stony Island avenue and Manhattan Beach lines during times of heavy traffic in summer.

The booster motor has a panel to itself on the switchboard, and is provided with a circuit breaker, main switch and automatic starting rheostat, which will return automatically to off position whenever the current is shut off for any reason, as by the opening of a circuit breaker.

The use of a motor to drive the boosters makes advisable a precaution that is not necessary where a steam engine is used. This precaution, which will be used on the South Chicago boosters, is to arrange a magnetic trip which will automat-

ically trip the circuit breakers in the boosted feeders whenever the current supply of the booster motor fails. There are two reasons for this. In the first place if the circuit breaker of the booster motor should open under heavy load the motive power of the boosters would be gone and the current flowing through them would stop them and eventually cause them to revolve in an opposite direction at a high rate of speed. In the second place it is necessary to open the booster circuit breakers before switching on current again after all the generator circuit breakers have opened, or the boosters will begin to revolve at a high rate of speed as motors in the opposite direction from that in which they are run normally. The time required to run to the booster circuit breakers and open them after the generator breakers have gone can be ill spared at such times when it is important to get current on the lines as soon as possible. If the booster circuit breakers are automatically opened when the current is shut off from the motor from any cause all these difficulties are overcome and there is no chance for an accident.

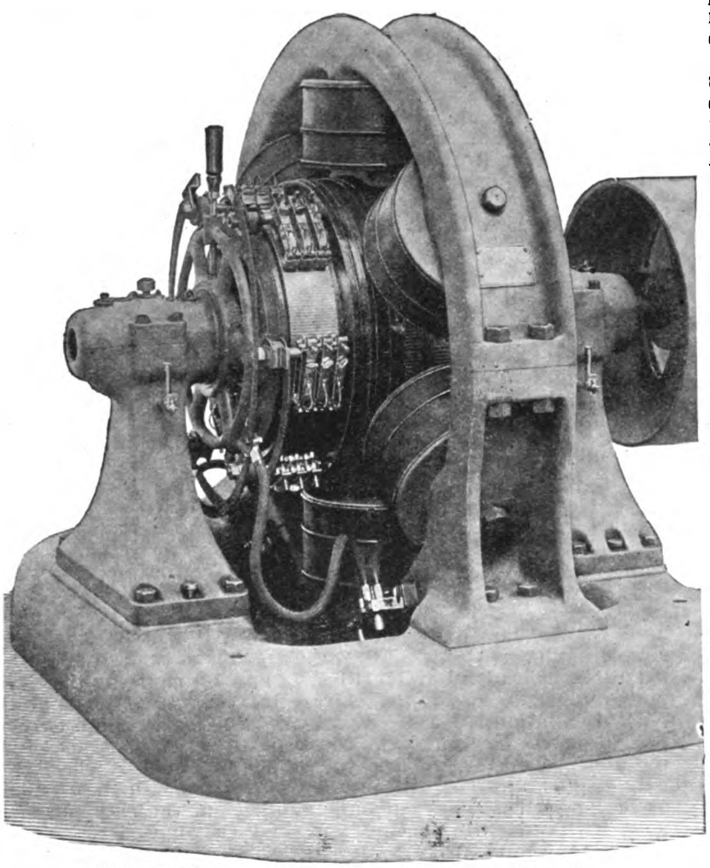
The switchboard panels used with these boosters are simply the modified feeder panels now commonly put in where new machines of this kind are installed. Each panel has a feeder circuit breaker and two switches. One switch is a single-pole, single-throw and serves to connect the negative of the booster to the positive station bus. The other is a single pole double throw switch and when the booster is in use is thrown so as to connect the feeder to the positive of the booster. Thrown the other way it connects the feeder direct to the positive station bus as when it is desired to feed direct without the booster.

In one instance the booster feeds into a section which is also fed from the power house direct. This arrangement gives no trouble when the voltage of the boosted feeder is not allowed to get high enough to make the booster feed more than its share of the section.

The station is in charge of R. C. Ogilby, chief engineer.

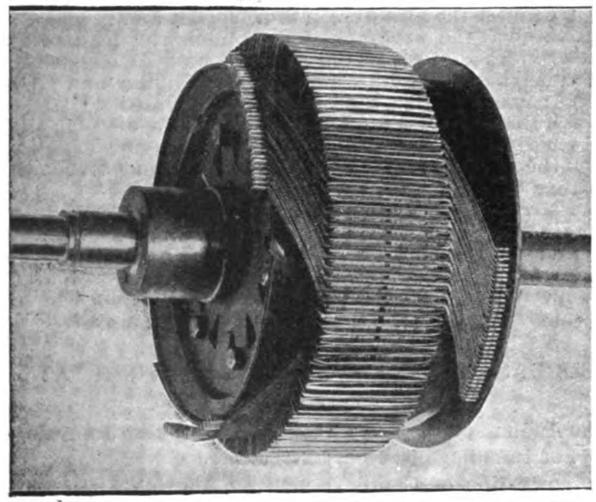
G. E. BELT DRIVEN RAILWAY GENERATORS.

So rapid has been the development of the railway generator directly conected to the driving engine, and so extensive its adaptation, that the railway public is liable to lose sight of the fact that the belt-driven generator is still greatly in demand. Many cases exist in which the conditions do not warrant the installation of direct connected apparatus, and to these cases the belt driven generator is more applicable.



New G. E. Belt Driven Railway Generator.

Improvements in belt-driven generators have kept pace with those in all other classes of electrical apparatus, and the distinguishing features of excellence of the General Electric Co.'s direct connected apparatus have been incorporated in its new line of belted machines. These are all six-pole generators, built in five sizes, ranging from 110 kilowatts to 500 kilowatts. That shown in the illustration is a 110 kilowatt six-pole 500 revolution machine.

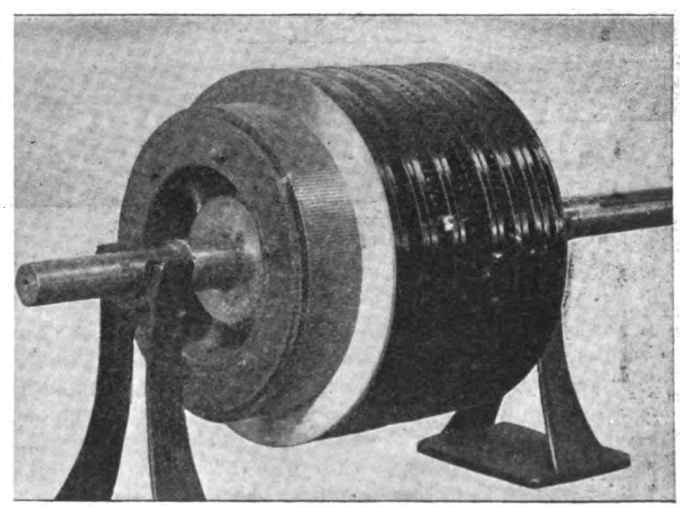


Armature Core Showing Coils.

The magnet frame is of cast steel heavily ribbed, making it both light and compact. Its magnetic efficiency is the highest obtainable. The bearings are built upon the ball and socket principle, are self-aligning and self-oiling. The armature shaft has been increased in size and the bearings lengthened, two features substantially guaranteeing cool operation. The steel poles and pole pieces are cast in one piece and so bolted to the frame that they may be easily removed without disturbing either the armature or the frame.

The series winding of the field coils is of flat copper ribbon, the shunt winding of wire. Instead of winding the series coil on the field spool and covering it with the shunt winding, both windings are placed side by side on the pole, and, being entirely independent, either may be removed without disturbing the other.

The armature is of the barrel wound type, such as is used in the General Electric direct connected generators. This method of winding gives the smallest number of joints, and facilitates any necessary repairs, as few coils need to be removed to reach any particular one incapacitated for service. The cast-iron flange, bolted to the armature spider at each end of the core, forms a support as well as a cylindrical receptacle for the projecting ends of the coils. The coils are secured firmly in the slots of the core, and the cross connections are made on the barrel flange. The projecting ends of the coils



Armature Core with Commutator Complete.

in the flange are thoroughly insulated and held in place by steel bands. The flange extension also protects the windings from any oil that may be thrown from the bearings. The surface of the interior of the armature is perfectly smooth, offering no opportunity for the collection of oil or dust.

Ventilation is effected by the use of specially constructed vanes forming air ducts between the laminæ of the core. These convert the armature into a blower, and create a strong draft through the windings. The commutator leads are taken directly from the coil to the segment immediately beneath it. The construction of the commutator is similar to that of the direct connected machine. It is ventilated by air drawn through the body and discharged through air ducts in the core. The small difference of potential between the segments secures the permanence of the insulation and freedom from sparking.

The strength of the magnetic field in these generators is so proportioned to the armature reaction that a constant brush lead and neutral point are ensured even with heavy overloads.

These G. E. belt-driven generators have only recently been introduced, but up to October 1, over 55 machines have been sold, aggregating considerably over 10,000 kilowatts.

SUBURBAN ELECTRIC RAILWAY WORK AT INDIANAPOLIS.

The Indianapolis, Greenwood and Franklin Railway Company, of Indianapolis, Ind., have elected a new board of directors, consisting of George E. Fisher, Detroit, Mich.; John C. Vanatta, Brookston, Ind.; Chas. F. Coffin, Indianapolis; James T. Polk, and John A. Polk, of Greenwood, Ind. Henry L. Smith has resigned, not now being connected with the enterprise. The company will complete the line from Indianapolis to Greenwood, a distance of ten miles, early this spring, the grading being completed, also the necessary stone arches. The power house will be located at Greenwood, a suitable site having been purchased, this being for the purpose of providing the proposed extension to Franklin, a further distance of ten miles. The power will consist of 700 h. p. in water tube boilers, compound condensing engines and direct connected generators. The line will be double trolley, figure 8, the track sixty pound "T" rails; oak hewed ties. Provision will be made for handling freight, the immense canning factory of James T. Polk alone requiring eight hundred freight cars during the season, there being but one outlet from this factory at the present time. Over half the capital stock has been placed and the company also have a subsidy of $34,000. Five per cent. twenty year bonds will be issued to cover part of the cost of construction. The board will meet in Indianapolis about the middle of January for the purpose of closing contracts for the work contemplated. George E. Fisher, 1113 Majestic Building, Detroit, Mich., is chairman of the executive committee, to whom all communications should be addressed.

MISCELLANEOUS

ON A COAL GAS ELEMENT.[1]—II.

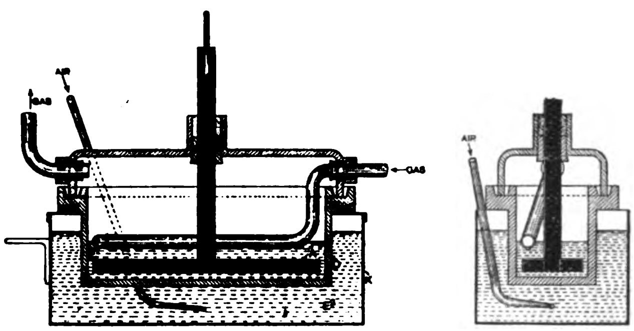
By DR. W. BORCHERS.

(Concluded.)

AND here permit me to lay special stress on one case. I had brought ammoniacal solution of cuprous chlorine under a glass bell (Figs. 4, 5, 8 and 9) and began to introduce illuminating gas without at first suspending the electrodes in the outer vessel. The whole interior of the bell, and what was below it, was covered in a short time with metallic copper. But as soon as I suspended the outer peroxide-electrodes and established a short circuit between the two, the glass bell became clear again, the copper passed into the mercury and through the same into the dilute sulphuric acid.

Practically, not much had been gained, as yet, with this combination, for to decompose ammoniacal solution of cuprous chloride, perhaps with great losses of ammonia, and to receive in return a weak current and a solution of sulphate of copper, was not an encouraging result; but, at least, it showed that the way to something better had at last been entered upon.

It was not a novelty to use lead peroxide-electrodes. Dr. Coehn had long since recommended them for his carbon element. Furthermore, after short reflection, I had to abandon them altogether, as such electrodes would make us dependent upon electro-chemical processes, which they would have to supply to us as by-products, so to speak. Also, when the lead peroxide electrodes are reduced they cannot be easily regenerated by means of the oxygen of the air. Manganese peroxide, on the other hand, is very easily regenerated. Gentlemen, you surely know the elegant Weldon process which has been of such great service to the Leblanc soda industry, the celebrated dioxide of manganese regeneration of the manganous chloride lyes precipitated during the production of chlorine, by means of lime and air. If you precipitate manganous chloride lyes with an excess of slaked lime, and, at a moderate temperature,



FIGS. 12 AND 13.

conduct air through this slime, the $Mn(HO)_2$, at first formed, rapidly passes into MnO_2. This affords us an ionizing means for the oxygen of the air such as few others can compare with.

Now, while retaining cuprous chloride for the solution of the carbonic gases, I replaced the chloride of copper formed in the anode cells from cuprous chloride and oxygen, by the so-called Weldon mud, manganese peroxide in basic solution of chloride of calcium.

Now, indeed, a porous diaphragm for separating the anode and cathode chamber was necessary, but now, also, it fulfilled its purpose. The oxygen transmitter was a solid body distributed in a liquid, and it was now an easy matter to take care that at the point of contact of the two liquids, in the diaphragm there should be formed precipitates that were insoluble, but allowed ions to pass through, and which prevented a mixing of the reagents.

Permit me now finally to pass on to the apparatus which I

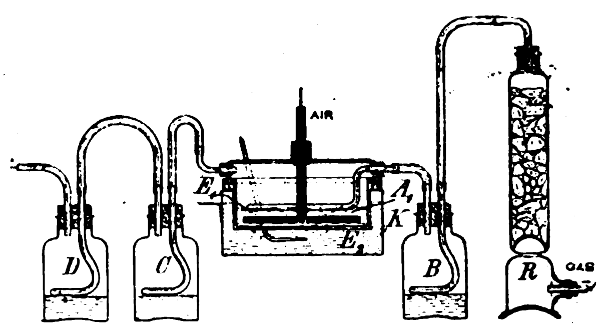


FIG. 14.

used for my last experiments. You see it has become very simple again.

An iron or leaden box K, (Figs. 12 and 13) contains the Weldon mud E^2; a suspended clay cell D contains the cuprous chloride solution E^1. Here a carbon plate A, set upon a carbon rod, forms the electrode. As before, coal gas is introduced into the anode chamber, air into the cathode chamber. The latter may also be omitted. In this case, you work with the element as long as it furnishes current, then lift out the clay cell, and now, with moderate heating, you send a strong current of air through the mud mixed with a little fresh lime paste, until it is again regenerated. For this point, regarding the Weldon manganese peroxide regeneration, I can refer you to Lunge's "Soda Industry," third edition, vol. 3, pp. 287-319.

Table I contains some results of measurements with this element. As solutions there served in the clay cell: 80 gr. of cuprous chloride, 100 gr. of sal-ammoniac, 50 gr. of sulphuric

[1] Read before the Verb. Deutsch. Electrotechniker.

acid, diluted with water to 500 cc. Here, as in the following cases, Weldon mud was always kept in the cathode chamber.

TABLE I.

External resistance ohms.	E. M. F. volt.	Strength of current ampere.
100	0.610	0.0100
90	0.600	0.0100
80	0.600	0.0100
70	0.600	0.0100
60	0.600	0.0100
50	0.600	0.0150
40	0.590	0.0175
30	0.580	0.0200
20	0.580	0.0300
10	0.550	0.0600
5	0.500	0.1000

I now refer to the following tables, results of measurements which were obtained, under otherwise similar conditions, with solutions which did not possess as great a solvent power for carbonic oxide, but the dissolved ingredient of which, just like cuprous chloride, was more highly oxidizable. The difference between the electromotive forces here attained and the above results is very remarkable. In all the following cases I limit myself to giving the name of the dissolved substances, as I note beforehand that the quantities of the same were always equivalent to the given quantity of cuprous chloride, with retention of the given volume of liquid and the addition of acid.

TABLE II.—STANNOUS CHLORIDE ($SnCl_2$):

External resistance ohms.	E. M. F. volt.	Strength of current ampere.
100	0.400	Hardly measurable.
50	0.380	0.0100
25	0.365	0.0175
20	0.350	0.0200
10	0.320	0.0350
5	0.280	0.0600
2.5	0.180	0.0900
0.5	0.017	0.1700

TABLE III.—MANGANOUS CHLORIDE ($MnCl_2$):

External resistance ohms.	E. M. F. volt.	Strength of current ampere.
100	0.175	Hardly measurable.
50	0.170	Hardly measurable.
30	0.160	Hardly measurable.
20	0.150	0.020
10	0.125	0.025
5	0.110	0.030
2.5	0.080	0.040
0.5	0.010	0.100

TABLE IV.—MANGANOUS SULFATE ($MnSO_4$):

External resistance ohms.	E. M. F. volt.	Strength of current ampere.
100	0.260	0.010
50	0.250	0.012
30	0.240	0.015
20	0.230	0.020
10	0.200	0.030
5	0.170	0.040
2.5	0.090	0.050
0.5	0.008	0.080

TABLE V.—FERROUS SULFATE ($FeSO_4$):

External resistance ohms.	E. M. F. volt.	Strength of current ampere.
100	0.080	Very weak.
50	0.075	Very weak.
25	0.070	Very weak.
20	0.070	Very weak.
10	0.050	Very weak.
5	0.035	Very weak.

Of course I have not neglected, in the first case, where I applied solutions of cuprous chloride, to take measurements also with electrodes between the material of which, as such, all difference in potential was excluded. For instance, by putting the Weldon mud into a porcelain bowl, and, as usual, suspending the clay cell, provided with cuprous chloride carbonic oxide solution, and using at one time platinum for both electrodes, at another time carbon for both, I obtained results which varied so little from those in table I that I need not specially cite them here again. It is thus clear that none of the electrode materials employed (C, Pb, Fe) had a part in the production of current.

There still arises this objection: That the results obtained could be put down to the account of the neutralizing action of calcium on acid, especially since I must admit that the maintenance of the capability for work of the element depends on the maintenance of the acidity of the one and the basic nature of the other cell contents. I therefore put dilute sulphuric acid, or hydrochloric acid into the dry cell and into the outer vessel (porcelain bowl) basic calcium chloride solutions, as it existed in the Weldon mud, and also even stirred lime water into the latter fluid. Both electrodes consisted of large platinum sheets. You will see from Table VI how small a part any possible neutralizing current seems to play in the actions of the first experiment.

More accurate investigations than I could have made with the comparatively rough means at my disposal for this purpose will be conducted in the laboratory of Professor Nernst, especially to clear up this point.

TABLE VI.

External resistance ohms.	E. M. F. volt.	Strength of current ampere.
100	0.0350	Scarcely measurable.
50	0.0350	Scarcely measurable.
20	0.0340	Scarcely measurable.
10	0.0340	0.010
5	0.0325	0.015
3	0.0310	0.020
2.5	0.0300	0.030
1.5	0.0260	0.040
0.5	0.0070	0.060

And now there still remains the important question to be answered: Do the expected oxidations really take place at one or the other electrode? Does oxygen or rather do HO ions travel to the anode? Or what other processes constitute the foundation of this element?

If we fill the clay cell with dilute sulphuric acid and the outer cell as before with manganese peroxide mud, sink a large platinum plate into the clay cell and establish a short circuit between it and the lead or iron box, the platinum plate will at once be covered with small oxygen bubbles. Thus the aerial oxygen blown into the outer cell was transferred into HO ions by the manganese combinations, which traveled to the anode and there were decomposed into water and oxygen. We can therefore not only obtain pure oxygen from air without any expenditure of electricity or heat by the help of manganese peroxide, but we can even derive from this process a small surplus of energy in the form of electricity, as indicated by Table VII.

TABLE VII.

External resistance ohms.	E. M. F. volt.	Strength of current ampere.
100	0.340	Scarcely measurable.
50	0.300	0.010
20	0.280	0.015
10	0.250	0.025
5	0.210	0.040
2.5	0.160	0.080
1.5	0.130	0.100
0.5	0.125	0.170

Under these circumstances we can certainly expect to bring about vigorous oxidation in the clay cell, and, that the so easily oxidized constituents of our gaseous fuels, if they be here liquefied by a proper solvent, will not only offer no resistance, but will even act to depolarize and thus to increase the electromotive force of the element. Free iodine or bromine were at once liberated from potassium iodide or potassium bromide when in these experiments I added them to the dilute sulphuric acid. Returning then to the coal gases there would still remain the question: What originates from carbonic oxide and from the other constituents thereof? With the expectation that all the carbonic oxide would be oxidized into carbonic dioxide I finally devised the following apparatus, Fig. 14:

The illuminating gas passed first through an apparatus R filled with fresh caustic soda, then through the flask B, filled with baryta water, which was to indicate whether the gas was really free from carbonic acid. The gas then passed through the element, and at last through the flasks C and D, filled with baryta water. Here, indeed, a turbidity due to the barium carbonate was soon visible, but the quantity thereof did not bear the least comparison with that which we could expect from the carbonic oxide contained in the illuminating gas.

But in spite of the slight quantity of carbonic acid obtained no oxidation of the cuprous chloride into chloride of copper took place. Other reactions must therefore have taken place, which are not wanting when so motley a mixture of hydrocarbon compounds and free hydrogen as is contained in illuminating gas is employed. And for the carbonic oxide, too, there was still a second product of oxidation, which I had formerly entirely neglected: Oxalic acid, which was indeed soon proved to be present. The discovery of this acid and with it the reaction: $2\ CO + 2OH = H_2C_2O_4$ at last explained the reason for the small formation of carbonic acid and the small product of current; but at the same time it opened up prospects of a number of reactions which will be of the highest interest to the organic chemist. We need only to think of the synthetic formation of carbon acids from hydrogen, hydrocarbons and carbonic oxide, beginning with formic acid.

And under these circumstances I trust you will pardon me for having again laid an unfinished work before you. Leaving aside the fact that since the beginning of my practice I have worked almost exclusively in the field of inorganic chemistry thereby wholly losing sight of things of preponderating interest to organic chemistry, I furthermore lack two factors, still more important perhaps for the successful accomplishment of the certainly promising labor, time, and, if I may use the expression, tools. The few spare hours still left to me out of the year are not enough to continue the experiments as they should be continued. Under the existing circumstances the experiments would in my hands drag along without ending. For this reason I am pleased to be able to inform you that fur-

ther investigations of this element have been begun in the laboratory of Professor Nernst, of Goettingen, and the laboratory of the Elberfield color factories.

I repeat also this time that the results thus far achieved are not yet of a nature to allow the element to be characterized as an appliance suitable for operations on a large scale, that is for doing away with our smoking furnaces; but a little step in this direction has been made. I hope, at all events, we have not arrived at unsurmountable difficulties, but at broader prospects of a final solution of this fascinating problem.

R. M. HUNTER'S PATENTS ON THE ALTERNATING SYSTEM.

We are in receipt of the following communication from Mr. R. M. Hunter, of Philadelphia:

There are three important patents generic to the alternating system issued this week to my assignees. The first of these patents, the one having the earliest number, is issued to G. W. K. Stephens, and the remaining two are issued to the General Electric Co. The first has a record date of 1883 and the latter two of 1887. The first of these patents covers generically the whole art of alternating systems using transformers for reducing potential, whether for lighting, motor or any other work. The seventh claim, for example, reads as follows:

"7. The method of transmitting electrical energy consisting in transmitting an electric current of high tension and small volume over a line circuit and at one or more places on the line circuit, producing by means of induction currents of low tension and relatively large volume, and supplying said low tension currents to one or more translating devices in said local circuits."

This is upon its face generic and includes about all the transformer work which is being done, or likely to be done in the future. This patent, notwithstanding that the application was filed fifteen years ago, will have a life of seventeen years from December 21, and all alternating work will be subject to it.

The next patent in order of number is also a very broad one, and while it also covers all the alternating systems employing reducing transformers as carried on, it nevertheless is subject to the first mentioned patent. Claim 4 of this application reads as follows, which will be a fair representative of the claims contained in it:

"4. The improvement in the art of transmitting electrical energy to and utilizing it at a distance from the source, which consists in generating maintained and practically uniform alternating currents of high tension at one station and sending the same over a line of conductors to another station, generating maintained and practically uniform alternating currents of lower tension at the second station by the inductive influence of the high tension currents, and converting these maintained low tension alternating currents into other forms of energy, such as heat, light, etc.

Both of the foregoing patents cover generically the reduction of potential. The last patent of the three differs from the first two in that it covers, in addition, the raising of potential. This patent, while not applying directly to the usual application of alternating systems to industrial work is generic to special applications thereof.

I would also remind you that two other of my patents cover generically the alternating system employing the "step-up" and "step-down" transformer principle. Of these No. 460,071, September 22, 1891, covers the method generically. This patent fully covers the long distance transmission work, for example, as found in the Niagara Falls Electric Power Co.'s work. The first claim of that patent reads:

"1. The method of transmitting electric energy, consisting in generating by induction currents of low intensity and of alternately increasing and decreasing potential, then converting them by induction into currents of high intensity, transmitting the induced currents of high intensity by a line circuit to a distant place, and then re-converting by induction said high intensity currents back again into low intensity currents and supplying said low intensity currents to one or more local circuits containing translating or current consuming devices."

The fifth claim is directly drawn to the multiple arrangement of the reducing transformers.

The other patent on this long distance transmission system covering the "step-up" and "step-down" transformer work, is No. 581,684, granted to me on April 27, 1897, containing 27 claims, of which the following is an example:

"17. The combination of a generator generating alternating electric currents with transformers for changing the current generator into a current of higher tension, and with mains for conveying this higher-tension current to other transformers at distant stations which reduce the current to a current of lower tension, and with distributing mains for conveying the reduced current to places where it is to be used."

There is little left to be claimed generically and certainly nothing but what would be subject to these patents, and especially the first one.

OHIO'S UNPROFITABLE INVESTMENT IN STATE CANALS.

Ohio has a canal problem and a commission appointed by the Governor is trying to solve it. The question involved is whether to abandon the canals, or to make them active competitors in transportation by improving them. A majority of the commission is said to be in favor of retaining the waterways, but that fact may not be positively known until report is made at the coming session of the Legislature. Advocates of maintenance are encouraged by the discovery of a fact, forgotten by most of the people of the State, that Ohio is under a compact with the United States government to maintain the canals. This obligation arose through the gift to the State of half a million acres of public lands, the proceeds from the sale of which went to the construction of the canals. In return for this, Ohio agreed to care for the canals and to allow the national government their free use for all time. It is held that the compact cannot be broken without the consent of Congress, and a precedent is cited wherein Illinois, which also received a land grant for canal purposes, found it necessary to secure the national government's consent before it could divert the proceeds of the grant from canal to railroad construction.

COSTLY CABLEGRAMS.

Sixteen thousand dollars is the record price paid for a cablegram, that price having been paid for a message sent by Mr. Henniker Heaton to Australia in behalf of the British Parliament. Reuter's account of the murderer Deeming's trial, 4,000 words, cost $8,000. An 1,800-word dispatch from London to Argentina cost $7,500. The most expensive private message so far is that sent by the King of Italy to the Duke of Abruzzi at Rio Janeiro, informing him of the death of his father, the late Duke of Aosta, which cost $2,670.

GOVERNMENT CONTROL IN GERMANY.

Mr. Poultney Bigelow writes to the New York World: While in the Berlin Royal Library recently I was struck by the fact that the building appeared to be anything but fireproof. The librarian said sadly:

"We petition the government repeatedly for better quarters, but it needs all the money for the army and cannot spare any for us."

The German schools and scientific institutions are being starved in order that more batteries may be added to the artillery. The last six months have been filled with most shocking railway accidents in Germany, nearly all of which have been traced to penurious treatment at the hands of the government.

LETTERS TO THE EDITOR

BELL TELEPHONE DIVIDENDS.

Your editorial on "Good Electrical Investments" exaggerates the amount of dividends paid by the American Bell Telephone Co. The regular dividend has been 12 per cent. for a great many years; how long I do not remember. The extra dividends have been either 3 or 6 per cent., making a total dividend of either 15 or 18 per cent. I think the dividends have been 15 per cent. for the past two or three years, and 18 per cent. for a long time before. I have had the pleasure of receiving these dividends for 15 or 20 years, but have no record of them. The true story is good enough, so I take the liberty to correct your slight inaccuracy.

BELL STOCKHOLDER.

Boston, December 24, 1897.

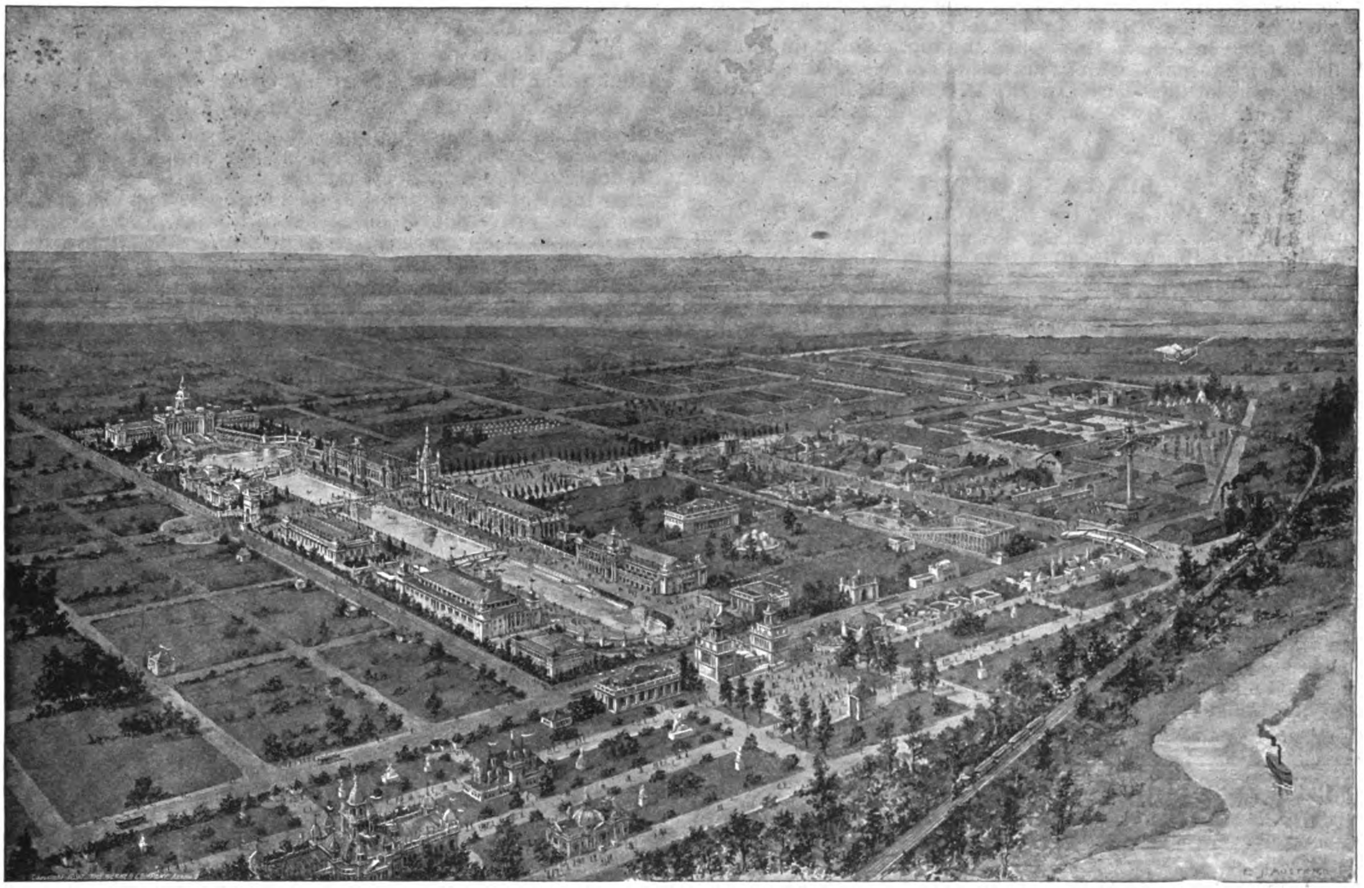
(We are without the exact figures for each year, but while we were possibly wrong, our friend's return on his investment may have been larger than he figures, and nearer our total estimate. Eds. E. E.)

NEWS AND NOTES

THE OFFICIAL PLAN OF THE OMAHA EXPOSITION GROUNDS AND ELECTRICITY BUILDING.

FROM time to time, we have given details in regard to the Trans-Mississippi and International Exposition, to be held at Omaha, Neb., next June to November. We are now able to print the cut issued by the authorities showing the distribution of the various buildings and annexes. Situated upon a broad plateau, well within the city limits on the north side, the Exposition grounds are easily accessible from all points of the compass. Kountze tract, 670 feet wide, defined by Sherman avenue on the east and Twenty-fourth street on the west, was selected for the focus of the group of main buildings. This ground is nearly half a mile long and in the center a canal extends the greater share of the distance. This basin is 150 feet wide at the east end, while at the west end it runs into a trefoil or three-lobed lake fully 400 feet across. On the east, lying at right angles to Kountze tract, is an area of sixty three acres stretching along the bluffs and overlooking the river and country beyond. The remainder of the Exposition grounds lies north of Kountze tract, west of Sherman avenue, and includes the old fair grounds and the land beyond it, embracing in all about eighty acres. Two viaducts across Sherman avenue connect the Bluff Tract with the Grand Canal Court and with the large area to the north. The northernmost viaduct immediately connects two sections devoted to concessionaires, the one on the Bluff Tract lying parallel to Sherman avenue; the other being west of the avenue—the midway leading westward to a connection with Twentieth street, which leads southward into the Grand Court. The main entrance is on the south line at the intersection of Twentieth street, through the Arch of States. Perhaps the most effective view of the whole grounds is to be found on the viaduct spanning Sherman avenue at the east end of the Grand Court and leading to the music pavilion, esplanade and park which will distinguish the Bluff Tract. The whole Tract is being transformed into a fine park, where the various State buildings are located and which is the admirable site of the Horticulture, Forestry, Dairy and Apiary buildings. A wide avenue leads back to the music pavilion where, around the band stand, will be placed seats on the terrace for 100,000 listeners. To the north lies the pleasure ground, where will be arrayed a remarkable assemblage of attractions. On the old fair grounds site the live stock and irrigation exhibits, the sugar beet fields, the great display of agricultural implements, alfalfa fields, the amphitheater and athletic fields are located. Trees will be made use of very freely in the form of parks and groves and for shading and ornamenting unsightly places. A rose garden will adorn the crest of the bluff.

At the west end the Mirror with its cluster of artistic accessories is itself to be the center of a beautiful park, whose winding walks and shaded arbors all lead to and frame this bit of water. Music pavilions, restaurants and other attractions will make the Mirror a favorite haunt for many visitors. Pleasure boats, launches and gondolas, as well as swans and other water fowl, will add to the interest and help to beautify the lake. In this "Mirror" will occur the water festivities, swimming and diving displays, etc., which can be observed from the colonnades and from the steps of the U. S. Government building, whose noble proportions are reflected by the sheet of water lying before it.



BIRD'S-EYE VIEW OF THE TRANS-MISSISSIPPI AND INTERNATIONAL EXPOSITION.

The Machinery and Electricity Building is located in the northeast corner of the grand court, being east of the Mines Building and across the lagoon from the Manufactures Building. The design is governed by the general conditions requiring harmony with the other buildings. The architecture of the group is modern renaissance.

The building is 304 feet front by 144 feet in depth. There are triple entrances on the main floor level in the center of the main front, and similar groups in the centers of the east and west fronts, with four emergency exits in the north wall. In front of the building, flanking both sides of the main entrance, is an open portico sixteen feet wide, running the entire front of the building. The center entrance feature projects beyond the portico, thus forming the grand entrance vestibule. The main floor covers the entire area of the building. Above is a gallery thirty-two feet in width, extending around the four outer walls. The gallery is reached by spacious staircases located in the front corners of the building. This leaves a high central court

248 feet long by eighty feet wide, lighted from the skylights and clere-story windows above the roof.

The character of the exhibits sheltered by this building is shown by the decoration. The ornamental spandrils and panels receive all of their motifs and suggestions from machinery. The cresting at the top is composed of cog-wheels, this principle being carried out in all of the decorations. The underlying principle and function of machinery is symbolized by the groups of statuary on the top of the building. At each of the four corners are groups representing the early supremacy of man over the untamed forces of nature. These forces are represented by wild animals. Men in their youth are seen subduing them for the simple purpose of escaping injury and the preservation of their own lives at the sacrifice of the natural forces. A higher supremacy is shown by the center group, which is the dominating figure of the entire design. In this man developed beyond the youthful stage, having wisdom, takes these same untamed forces of nature and harnesses them to his chariot, making them do his bidding, symbolizing the service which machinery does for man in using the powers of steam, fire, electricity and gravity.

Color enters into the design with maximum importance. The ornaments in the panels under the porticos and over the main entrances will be highly emphasized by small background spaces of strong colors. These are treated in such a way as to give great interest to the spectator near by without detracting from the general quiet and dignity of the view from a distance. The entire building will be a series of yellow and ivory tones, growing more intense as they reach the top, culminating in the dull golden statuary which surmounts the building. The building was designed by Dwight H. Perkins, architect, Chicago. Prof. R. B. Owens has been very successful in obtaining electrical exhibits.

SLAG AS BALLAST.

Engineer M. W. Lee of the B. & O. lines west of the Ohio River has been experimenting during the past year or two with slag for ballast. His plan is to put about one foot under the ties and it makes very good ballast. About 18 miles of the Akron division have been improved in this way, but Mr. Lee's preference is for gravel when he can get it. During the past season on the Trans-Ohio division he has put in 143 miles of new ballast, the principal part of which was good, clean gravel. In addition to the ballasting, the Trans-Ohio division has had 460,981 new cross ties, and there have been 31 miles of new 75 pound steel rail laid, replacing 60 pound rails.

ELECTRIC LIGHTING GROWTH IN BOSTON.

The Boston Electric Light Co. has decided to have a large plant in South Boston, and has purchased the former shipyards of Harrison Loring. The property is situated on First street, between L and M streets, and contains some 16 acres of solid land and flats running out to the reserved channel. The water front is about 500 feet. This parcel is below all the bridges and will be used by the company for a new electric light plant. It has been deprived of its water front at its present location on Fort Point channel and Summer street by the extension of Dorchester avenue to Congress street.

PERSONAL

A POPULAR MAN AND A POPULAR PETITION.

Mr. Alexander Henderson, who is in charge of the Electrical Bureau at the Fire Department Headquarters, New York City, is evidently an extremely popular man in the trade. Although he stands in the position of censor or fault-finder in connection with the electrical installations of this city, his friends seem to be many. A petition is being circulated at the present time, addressed to the Honorable Commissioner of Public Buildings, Lighting and Supplies, under whose department the charter of the greater city places the Bureau of Electrical Appliances, requesting that Mr. Henderson be retained in charge of the department under the new administration. The petition sets forth his ability and gentlemanly characteristics, and states that he has passed an exceptional examination for the position which he now holds.

The signers of this petition at the present time represent nearly two hundred millions of dollars invested in the electric lighting and power field in this city. A petition of this kind certainly gives evidence of something more than the ordinary petition circulated by politicians.

Mr. Henderson's friends have taken this matter in hand without consulting him and have asked that no names be mentioned for the present, but seventy-five of the most influential electric lighting companies, electrical contractors, engineers and electrical manufacturers are now attached to this request.

MR. NIKOLA TESLA furnished a New York Herald man lately with some charming chat about the way they celebrate Christmas in his native mountains that overlook the Adriatic in the Austro-Hungarian province of Lika.

SOCIETY & CLUB NOTES

CHICAGO ELECTRICAL ASSOCIATION.—ELECTRICITY IN MISCELLANEOUS WORK.

THE Chicago Electrical Association meeting on the evening of December 17 was given over to an informal discussion of a number of topics. The paper, which was to have occupied the evening, by Mr. C. C. Mattison, on Electricity in Ship Building, was postponed owing to a death in Mr. Mattison's family.

Mr. Edward W. Jewell occupied a few minutes with a review of the legitimate uses of electricity in medicine, a subject about which the average electrical engineer knows very little, as electro-therapeutics forms a branch by itself, belonging to the medical rather than the engineering field. Among recent important advances of general importance he mentioned the deadening of pain in dentistry by electrolytic infusion of cocaine into the nerve tissue before an operation. In this process the negative pole is connected to the jaw and the positive to a pointed electrode carrying a piece of cotton filled with cocaine, which is applied to the exposed nerve. A 15-minute application will infuse cocaine into the nerve to deaden all pain for subsequent operations. Where sound teeth are to be pulled the cocaine is infused into the gum. Operations to remove the growth in the nose caused by catarrh, which formerly required the use of a cautery or burr and which left a scar, destroying the normal functions of the nasal membrane, can now be performed by passing a very small current between two needle points stuck into the growth. This coagulates the albumen in the growth and stops up the capillaries to the enlargement of which the growth is due. The nose is left after such operations in a perfectly normal, healthy condition.

President McMeen then described the rheostat designed by Mr. Jewell for obtaining any potential desired for medical purposes from 110 volt circuits. It consists of a graphite resistance permanently connected across the 110-volt mains. The drop of potential between two points of the rheostat gives any desired voltage and the voltage can be varied from zero up to 110 with perfect smoothness, an important feature, as in some operations the sudden application of a small fraction of a volt causes great pain.

W. R. Garton spoke a few words on the electric railway manager and the supply man, explaining some of the difficulties encountered due to a demand for cheapness without regard for quality.

W. A. Harding then gave a number of exceedingly interesting and valuable pointers regarding the management of electric railway shops and explained very definitely why such expensive results are often obtained. He spoke from his personal experience on various electric roads. Lack of uniformity in equipment is one great source of waste. Some large roads furnish excellent examples of uniformity and economy, all motors and trucks being exactly alike, while many small roads present an unlimited variety of apparatus, which necessitates a large stock of supplies and a lack of familiarity of the men with various equipments. On one road running 85 cars he found five armature winders. It was seen there was something wrong. Investigation showed that the trouble was lack of care in insulation and handling. Armatures would sometimes come back to the shop three times in succession before the winders would do a good enough job so that the armatures would stay out on the road. The armature winding force was reduced to two good men. Provisions were made for more care in handling between motors and winding room. Much trouble had been due to lack of appliances for handling armatures so that an armature was fortunate if it did not pick up a nail off the floor or get injured by the motor casing before it got to its proper place in the motor. A small truck for wheeling armatures was made. Cranes were made for swinging armatures out of motors after the car bodies had been taken off the

trucks, and for putting armatures in the lathe. Instead of three or four men grunting over an armature and perhaps letting it down on a sharp corner to rest, one man could then handle an armature with the cranes. By these and other economies a repair shop force of 80 men was reduced to 20. Mr. Harding had been driven at one time by circumstances to study commutator wear, and the result is that he no longer considers turning down commutators as necessary or advisable and does not make a practice of it. He has a plan which will make them wear down to the thickness of cardboard without pitting or scoring or needing turning down. His plan is to soak all motor brushes every day in hot vaseline. This is done by having a double set of brushes. About 5 p. m. every day a set of brushes, to be used that night, are set to soak in hot vaseline and left there until the night men begin their work. A boy then takes them out of their vaseline bath and puts them in a box which is partitioned off to receive in each section the four brushes for each motor car. Each partition has the car number on it and each brush has the car number and exact location on the car indicated on it so that the same brush always goes in the same holder of the same motor. It takes the boy about half an hour to sort out the brushes for 60 cars and put them in the box in their places. The inspector carries the box around with him and instead of taking the brushes out and putting the same ones back again, changes them for the new set. The set he takes out is soaked the next evening and so on. Commutators are never touched with sandpaper. The rounding tips of the brushes are just touched with sandpaper, frequently to keep the wear at the ends from getting ahead of that in the middle. Before brushes are put in service they are boiled in paraffine so that there will be a lubricant left to feed down when the brush is heating and the vaseline is all run out. Mica for commutator segments should be of the soft amber kind. A harder, better quality, should be used at the commutator ends where there is higher voltage, but between the segments the soft is better. On commutators having hard mica between segments much trouble with pitting and burning is prevented by scratching out the mica between segments occasionally with a sharp tool. By the treatment outlined commutator segments one-eighth-inch high have been run 12 months and kept in perfect condition without wearing out or turning down. As to vestibules, not always the strongest is the best. Something flimsy and cheaply repaired is more to be desired than something very substantial, as vestibules are always liable to accidents.

After Mr. Harding's remarks W. Clyde Jones spoke of new patent laws going into effect January 1 and K. B. Miller told of present tendencies in telephone practice.

The annual election of officers then took place and the following will hold office during 1898: F. S. Hickok, president; Thos. G. Grier, vice-president; J. R. Cravath, secretary; E. J. Swartout, treasurer; S. G. McMeen, J. M. Hollister and C. Wiler, directors.

The next meeting will be held at the usual place, 1737 Monadnock Building, January 7, 1898, the paper being on "Electrical Shop Transmission," by H. G. Dimmick, of the Western Electric Co., and will have special reference to the transmission in that factory.

ANNUAL MEETING OF THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The sixth annual convention of the Northwestern Electrical Association will be held at the Hotel Pfister, Milwaukee, commencing on Wednesday morning, January 19, next. All interested in electrical matters, whether members or not, are cordially invited. The Entertainment Committee state that their arrangements made with the new management of the "Pfister" insure perfect satisfaction to all members and visitors. Direct and alternating current will be provided for exhibits. One and one-third railroad rate can be secured, conditioned upon 100 certificates of attendance. Mr. Frank L. Perry, 510 Marquette Building, Chicago, will have charge of transportation of delegates coming from, or through, Chicago. Papers on "Practice and Theory," "Present Efficiency of Incandescent Lamps," "Notes on Municipal Ownership," "Physical and Chemical Properties of Volatile Oils in Boilers," "Electric Lighting for Profit," "Long Distance Transmission" and "Transformers" will be presented by John C. McMynn, of Illinois; John E. Randall, of St. Louis; Fred DeLand, of Chicago; Wm. H. Edgar, of Illinois; Alex Dow, of Michigan; Axel Ekstrom, of New York, and E. H. Abadie, of St. Louis. An enjoyable pleasure programme will be provided. Members owe it to their own, as well as to the Association's, interests to attend this meeting. Mr. T. R. Mercein, 511 Montgomery Building, Milwaukee, is secretary.

LITERATURE

A HISTORY OF ELECTRICITY.

Dr. Park Benjamin's classical and interesting book on the origins of the art, entitled "The Intellectual Rise In Electricity," is now being published by John Wiley & Sons, 32 East Tenth street, New York City, as "A History of Electricity." The new title should help the sale of this book, which deserves as wide a popularity as has ever been secured by any work devoted to the subject. Dr. Benjamin writes clearly, forcibly and brilliantly, and while his work is as fascinating as a novel, it is a mine of medieval and technical lore. The work is well illustrated and contains 611 pages, royal octavo. The new price is only $3.

LEGAL NOTES

RIGHT TO REMOVE OVERHEAD WIRES.

The Electric Power Company for several years had a system of electric wires in this city for conducting and distributing electricity, which it maintained with the consent of the Board of Electrical Control until sufficient subways should be built for their reception. In 1890 the company was notified by the mayor to place its wires within ninety days in the electrical subways or conduits in the streets, and in 1891 the Board of Electrical Control requested the mayor to order the removal of these wires. Six months afterward, by direction of the mayor, the wires were cut down by the Commissioner of Public Works. The company then brought an action in the Supreme Court against the Mayor and others to compel the restoration of the wires, or, in the alternative, to recover damages. Justice McLoughlin, before whom the case was recently tried, has given judgment against the plaintiff, dismissing the complaint on the merits, holding that the company had no right, in the first instance, to string its wires, or thereafter to use them, and, not having availed itself of the opportunity to place the wires in the subways, it was the duty of the Commissioner of Public Works to remove them, as being a public nuisance and constituting a source of danger to person and property. "It is a well-settled principle of law," Justice McLoughlin said, "that any injury to or destruction of property necessarily incident to the exercise of the jurisdiction to summarily abate a nuisance interferes with no legal right of the owner, and it not violative of the constitutional prohibition against depriving the owner of his property without due process of law. Therefore any injury which plaintiff sustained by reason of the wires being removed from the streets by the Commissioner of Public Works is not actionable, When cut down, it was his duty to remove it, and thus clear the street of obstructions."

THE STOCK MARKET

GOOD CHRISTMAS CONDITIONS.

Dullness has been a usual condition of the Christmas stock market of late years, but last week found Wall street very cheerful and prices firm. The reason perhaps are not far to seek, lying in the good railroad earnings and the rehabilitation of several railroad systems; the large export trade; the good prices for grain, the brisk demand for securities, the larger requirements for iron and steel, and above all the universal reports of a heavy Christmas trade and Christmas travel.

Last week, a short one, 10,572 shares of Western Union were dealt in up to 90; General Electric 3,730 up to 33⅞, and American Bell Telephone 372 shares at 264.

OBITUARY

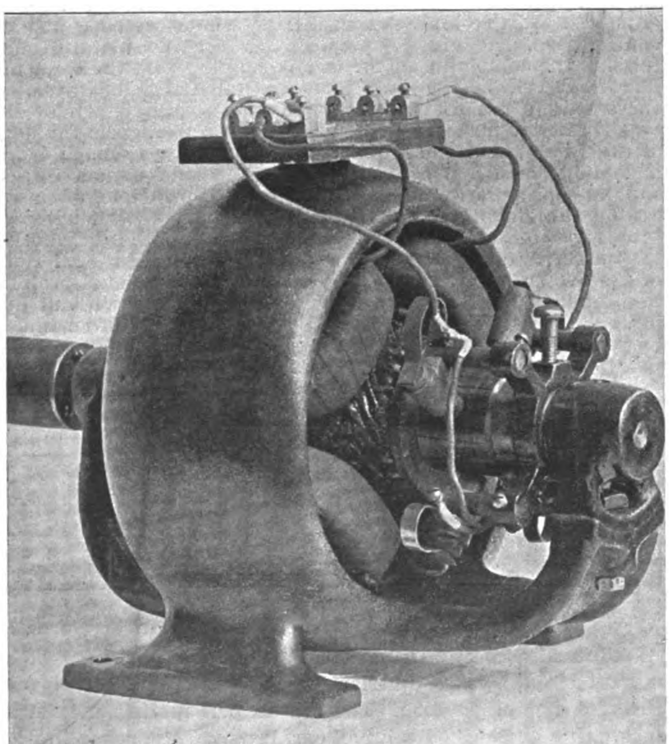
LIEUT. WM. M. WOOD, U. S. N.

Lieutenant William Maxwell Wood, of the United States Navy, died suddenly of heart disease at New Rochelle, N. Y., December 16, at the age of 47 years. He was well known as an inventor. He invented the safety appliance for launching lifeboats from ships at sea, mechanical ice making machines in use upon many vessels, and become known in electrical circles through his application of the process of welding metals by electricity as applied to military projectiles and for other purposes. At the time of his death Lieutenant Wood was detailed on scientific duty at Bridgeport, Conn.

EDUCATIONAL

A DYNAMO FOR STUDENTS OF ELECTRICITY.

THE illustration herewith shows a new design of a dynamo for experimental purposes, manufactured by the Institute for Home Study of Engineering, of Cleveland, O., for its students. It is a high-grade commercial machine adapted to experimental work, the idea in furnishing such a machine being that after the student has finished his course, he can use it for ordinary and any work. When the student reaches that part of his course treating of dynamo construction, he receives the machine, with every part finished and with all materials for winding, i. e., making the armature complete and putting on and connecting the field coils. This work is a part of the electrical course of the Institute. When it is completed, the student uses the machine experimentally during the remainder of his course. The cut shows the machine com-



A DYNAMO FOR STUDENTS OF ELECTRICITY.

plete. The armature is of the drum type with laminated core. The commutator is long in order that collector rings for taking off currents uncommuted, in from one to four phases, may be slipped on it, together with the new set of brushes required. When operated as an alternating current machine, it excites its own fields.

The range of experimental use is wide. The machines built by the Institute have been found to be so well adapted for instruction purposes that they are now in use in a number of schools and colleges. The teachers of electricity find that the practice of winding and connecting the machine is of great value to the students. A full description of the process of winding accompanies the machine when sent to technical schools.

INVENTORS RECORD

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED DECEMBER 21, 1897.

Alarms and Signals:—

CIRCUIT CLOSING DEVICE FOR BURGLAR ALARMS. E. E Wilson, Blackwood, N. J., 595,842. Filed Aug. 18, 1897. Employs a window spring to close the circuit when the sash is moved.

ELECTRIC BURGLAR AND FIRE ALARM. C. J. Bukoutz, Lamoille, Ill., 595,871. Filed April 19, 1897. Details of construction.

ELECTRIC BURGLAR ALARM. D. W. McCaughey, Chicago, Ill., 595,963. Filed Nov. 27, 1986. Comprises a contact point mounted in a longitudinally movable insulating block, protected at one end by a hard metallic sleeve and an outer hard metallic tube in which the parts are mounted.

Batteries, Secondary:—

ELECTRIC ACCUMULATOR. C. P. F. Clere and A. G. Pingault, Paris, France, 595,695. Filed Dec. 5, 1896. Embodies a non-conducting covering for each plate to retain any active material that may become separated from the electrode.

Conductors, Conduits and Insulators:—

SUSPENSION OF AERIAL CABLES. G. Cameron, Boston, Mass., 595,693. Filed July 24, 1897. Comprises a plurality of poles, a cable and a supporting wire attached to each pole, with hangers between the wire and cable, consisting of a hook and a flexible insulating cord wound around the cable.

INSULATING BRACKET. C. A. Woolsey, Brooklyn, N. Y., 595,827. Filed March 29, 1897. Comprises a removable cap, a slot therein, a clamping jaw movable out and in the slot, and a clamping bolt having a threaded engagement with the cap and swiveled engagement with the jaw.

Distribution:—

ELECTRICAL TRANSMISSION OF ENERGY. R. M. Hunter, Philadelphia, Pa., 596,002. Filed Nov. 9, 1897. High potential currents are transmitted to sub-stations and transformed to low potential currents by means of secondary generators. (See page 632.)

ELECTRICAL TRANSMISSION OF ENERGY. R. M. Hunter, Philadelphia, Pa., 596,041. Filed Feb. 23, 1883. Similar to above.

TRANSMISSION OF ELECTRICAL ENERGY. R. M. Hunter, Philadelphia, Pa., 596,042. Filed June 18, 1897. Similar to above.

Dynamos and Motors:—

ELECTRIC MOTOR. M. B. Pengnet, Cambridge, Mass., 595,731. Filed March 31, 1897. A high speed motor designed especially for driving egg beaters, drills, jewelers' lathes, etc.

ELECTRIC MOTOR. F. E. Whipple and C. A. Stauffer, Philadelphia, Pa., 595,898. Filed May 1, 1896. Comprises a stationary external armature having three or more electrically disconnected coils, a common terminal, means for establishing an electrical connection between one end of each of the coils and the common terminal, and a central revolving field.

INDUCTOR GENERATOR. P. W. Power, Pittsfield, Mass., 596,032. Filed Sept. 10, 1897. An inductor generator having two crowns of induced coils on the interior of a cylindrical armature.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. A. Blahnik, Paris, France, 595,936. Filed July 10, 1896. Regulating apparatus for arc lamps. Details of construction.

Measurements:—

WATT METER. E. K. Adams, New York, 595,751. Filed Sept. 11, 1897. Employs an arm capable of displacements proportional to the logarithms of the number of watts in the circuit to be measured, an index and means for converting the displacements to displacements of the index.

METHOD OF AND APPARATUS FOR MULTIPLE METERING OF ELECTRIC CURRENTS. E. Oxley, Washington, D. C., 595,821. Filed Oct. 25, 1897. Consists in electrically operating a control apparatus from a single point by circuits composed of one or the other of the mains of the system in conjunction with the ground.

ELECTRIC METER. W. S. Weeston, Chicago, Ill., 595,841. Filed May 24, 1897. Eliminates the employment of the commutator in direct current recording meters.

Miscellaneous:—

ELECTRIC FURNACE. J. E. Hewes, Philadelphia, Pa., 595,712. Filed April 27, 1897. Means for continuously moving a suspended electrode for stoking the superimposed material into the path of the current. For calcium carbide manufacture.

GYROSCOPIC CONTROLLED FIRING MECHANISM FOR SHIPS GUNS. L. Obry, Austria-Hungary, 595,820. Filed Sept. 28, 1895. Means for discharging guns when the ships axes are in a horizontal position.

ELLECTRIC ELEVATOR. A. L. Duwelius, Cincinnati, O., 595,874. Filed Feb. 18, 1892. Controlling mechanism.

ELECTRICAL MUSICAL INSTRUMENT. G. A. Brachhausen, Rahway, N. J., 595,901. Filed July 3, 1897. Comprises an electrical shocking device, the operation of the electrical shocking device being governed from an element of the music-playing devices of the musical instrument.

Railways and Appliances:—

REVERSING AND CUTTING OUT SWITCH FOR ELECTRIC MOTORS. T. Von Zeigbergk, Cleveland, O., 595,868. Filed Sept. 20, 1897. Adapted to control four motors. Details of construction.

Roentgen Rays:—

METHOD OF AND APPARATUS FOR CONVERTING X RAYS INTO LIGHT FOR PHOTOGRAPHIC PURPOSES. T. B. Kincaide, Boston, Mass., 595,213. Filed Jan. 15, 1897. Consists of a surface, comprising a gelatin vehicle carrying a substance capable of transforming the invisible X-rays into visible actinic light.

Switches, Cut-Outs, Rheostats, Etc.:—

ELECTRIC SWITCH. H. F. Kleinschmidt, Hamburg, Germany, 595,777. Filed Nov. 16, 1896. Comprises a channeled rail-conductor and a switch box supported by the feeder, its parts braced against the upper and lower flanges of the rail conductor.

AUTOMATIC SWITCH FOR ELECTRICAL APPARATUS. S. L. Barriett, New York, 595,803. Filed Sept. 9, 1897. Employs an arm moving over successive contact points, and an electro-magnet having a curved segmental band-armature, which acts to maintain the arm in contact with any one of the contact points against the action tending to return the arm to off position.

HIGH TENSION SWITCH. H. Muller, Nuremburg, Germany, 595,887. Filed June 2, 1897. Consists of groups of contact rollers mounted on spring arms, each being normally out of contact with the others, and means for forcing them into contact with each other, while simultaneously a turning motion is imparted to the same.

PLUG CUT OUT. F. S. Richmond, Chicago, Ill., 595,970. Filed Jan. 8, 1897. Details of construction.

Telephones:—

TELEPHONE REPEATER. W. H. W. Weaver, Macon, Ga., 595,983. Filed Sept. 4, 1897. Consists in the arrangement of receivers and transmitters in connection with a common return wire forming four circuits.

TELEPHONY AND TELEGRAPHY. M. Hutin and M. Leblanc, Paris, France, 596,017. Filed Jan. 31, 1893. Consists in passing over a line waves of alternating current of such high frequency as only slightly affect the receivers and modifying the amplitudes of these waves in accordance with the desired message.

AUXILIARY APPARATUS FOR SELECTIVE ELECTRICAL SIGNALS. G. W. Whittemore, Brooklyn, N. Y., 596,036. Filed Sept. 2, 1897. Party telephone line system.

TRADE NOTES & NOVELTIES

THE "ELECTRA" CARBONS.

Mr. Hugo Reisinger, 38 Beaver street, New York, sole agent for the celebrated "Electra" Highest Grade Nuernberg Carbons, desires us to print the following notice in refutation of statements recently made in trade papers: "I wish to inform the trade that the word 'Electra' has been properly registered by me as my trade mark and therefore cannot be used by anybody else without infringing on my rights. The 'Electra' carbons are made, as heretofore, by the world renowned firm of C. Conradty, Nuernberg, who owns not only the oldest, but the most extensive, carbon works in existence, and whose carbons remain unequaled in quality and efficiency, having become the standard for electric lighting the world over. As to parties reported as makers of 'Electra' carbons, I wish to state that I have brought suit against them for having misused the trade mark 'Electra,' and that they have been enjoined by the Nuernberg courts from making any carbons stamped 'Electra' under penalty of 100 marks for each carbon. I shall guard the interest of buyers of my carbons as heretofore, and any information in regard to infringement on the registered trade mark 'Electra' that will enable me to take legal proceedings will be a favor."

THE MAGNOLIA METAL CO.'S CALENDAR.

THE above company, who are owners and sole manufacturers of the world-renowned "Magnolia" metal, have just given out a calendar for 1898 in which excellence of material and neatness of design rival each other. On a 6 by 7 inch bevelled celluloid slab, in red and black, appear their name and agencies and a variety of uses for which the metal is specially adapted are enumerated. An easel support is attached to the back. The "Magnolia" metal is in use by ten leading governments, and has long been recognized as a standard material for the bearings of engines, dynamos and machinery for all purposes.

The Magnolia Metal Co. may be addressed at 266-267 West street, New York.

McGILL & POMEROY'S CALENDAR.

MESSRS. McGILL & POMEROY, Monadnock Building, Chicago, have favored their friends with a calendar for 1898, on which a steel engraving, entitled "The Chrysanthemum" respresents a young lady wreathed in smiles and the flowers above named, and half reclining on a couch strewn with rugs. It is a creditable specimen of engraving work. It may be mentioned that Messrs. McGiL & Pomeroy, as agents, handle the Ohio Brass Co.'s street railway supplies, Adams-Bagnall arc lamps, Peru Electric Mfg. Co.'s porcelain specialties, Akron Insulation & Marble Co.'s clay bushings, Mertes Mfg. Co.'s gears and pinions, Orient incandescent lamps, "Monarch" insulating paint and rubber covered, weatherproof and bare copper wire.

UNION EQUIPMENT CO.

The Union Equipment Co. has been incorporated under the laws of New Jersey to make electrical appliances and equip roads. The capital stock is $1,500,000. The incorporators are F. H. Hitchcock, G. R. Gardner, and F. J. Bayer, of New York; F. W. Hunter, of Cranford, N. J., and F. G. Gourley, of Stamford, Conn.

ADVERTISERS' HINTS

THE COSMO ELECTRIC CO., 30 West Randolph street, Chicago, call attention to their No. 2 instrument as a perfect telephone for small exchange use. It is adapted to work drops and ring bells. It has no back board or battery box attached, the batteries being placed on the floor or in an adjoining closet or shelf. It is sold at $6.50.

THE JOHN STEPHENSON CO., New York, built their first car in 1831, and are still building others.

THE BOILER EXPURGATOR CO., 115 Dearborn street, Chicago, Ill., have appointed the Electric Applicance Co. as their exclusive Chicago agents for the sale of Holm's Tesoline commutator compound.

THE BOSSERT ELECTRIC CONSTRUCTION CO., Utica, N. Y., note the special advantageous features of their split steel junction boxes.

HUGO REISINGER, 38 Beaver street, New York, says that no matter what the dynamo and lamp may be, it is impossible to produce the best light without the best carbon, and in this connection he recommends the selection of the "Electra" brand of high grade Nuernberg carbons.

THE AMERICAN ELECTRICAL HEATER Co., 197 River street, Detroit, Mich., advertise a large variety of heaters and irons for many purposes.

THE DIEHL MFG. CO., Elizabethport, N. J., illustrate and describe some types of their improved arc lamps for outdoor and indoor lighting.

THE ELECTRIC STORAGE BATTERY CO., Drexel Building, Philadelphia, Pa., have secured the contract for installing 166 of the chloride accumulators having a capacity of 5,000 h. p. hours' capacity, for the Chicago Edison Co.; and the largest storage battery plant for trolley regulation has been contracted for by the Buffalo Railway Co.

PRATT & WHITNEY, Hartford, Conn., advertise tool room equipments and plants for manufacturing typewriting machines, sewing machines, etc.

EDWARDS & CO., 144th street and Fourth avenue, New York, furnish the "N. Y." door and window springs, and an endless variety of supplies which will be found listed in their catalogues.

THE INTERIOR CONDUIT & INSULATION CO., 20-22 Broad street, advertise the Lundell motor for direct connection to all kinds of machinery.

NEW YORK NOTES.

NEWBURGH, N. Y.—The armory at Newburgh, N. Y., is to be enlarged and improved, and when completed, will be one of the most convenient and complete company drill halls in the State, being about 80 feet wide and 130 feet long. Among the contemplated improvements is the removing of the present wooden roof and replacing it with a new roof structure. The roof supports will consist of eleven steel trusses. These will be arranged to support the mezzanine floor, where new lockers and equipment cases will be placed, and they will also support the visitors' gallery. The new roof when completed will be much lighter and will give the interior of the building a more

roomy and substantial appearance. The Berlin Iron Bridge Company, of East Berlin, Conn., have the contract for furnishing and erecting the steel trusses, as well as the other iron work in the building, consisting of steel plates in the rifle pit, girders in the floor and walls, and other miscellaneous iron work.

THE UNDERWRITERS' FIRE EQUIPMENT CO., of Brooklyn, has been incorporated with the Secretary of State to manufacture and sell a dry gas extinguisher for extinguishing fires, so constructed that when turned bottom up it throws dry carbonic acid gas and when turned back it throws liquid. The capital stock is $150,000, consisting of shares of $50 each, and the directors for the first year are A. C. Rowe, of New York, Robert Brown and Frank C. Mason, of Brooklyn, and Frederick Pearce, Frank McGurk, Charles McGuire and Denis J. McCarthy, of New York. It is thought likely to prove a good thing for switchboard protection.

LONG ISLAND.—President Baldwin, of the Long Island Railroad, is said to be considering the equipment of three of his lines with electricity.

MR. JOS. BURKART has sold his interest in the firm of Burkart & Ardmagyer, 4 2 Western Boulevard, and has opened an office at 1123 Broadway, Townsend Building, Room 721, where he will give personal attention to electric light wiring, bells, burglar alarms, gas lighting, motors and dynamos.

RAHWAY, N. J.—Mr. U. M. Osborn, chairman of the lighting committee, proposes a municipal plant at a cost not to exceed $30,000 and to be run at an annual cost of $9,000, giving 60 arcs and 2,500 incandescents.

BROOKLYN BRIDGE.—Justice Andrews, in the New York Supreme Court, has continued the injunction against the trolley loop on the Bridge and questions the authority of the trustees to permit the laying of the tracks for street cars.

BROOKLYN TROLLEYS.—The Brooklyn Board of Aldermen granted rights of way over some 50 miles of street to the East River Railroad Company, but the grant has been checked by injunction. The franchises are in consideration of 3 per cent. of the gross receipts to the city, and six car tickets for 25 cents.

THE PELHAM PARK RAILROAD COMPANY secured a good franchise recently, but attempts are being made to prevent it from going into effect as it stands.

FLUSHING, L. I.—The Flushing Gas and Electric Company have placed the contract for the extension of their generator plant with the Berlin Iron Bridge Company, of East Berlin, Conn. This extension will be built in a fireproof manner, having steel framework and trusses covered with corrugated iron roofing.

CLYDE, N. Y.—The Clyde Electric Light and Power Company, C. W. Field, president, and L. L. Moses, secretary and treasurer, are adding a power circuit. They are in the market for 500 volt direct current motors and meters for alternating current. Mr. Moses informs us of several additions made lately to their plant, including an Ames engine, 1,500 light Fort Wayne alternator and a 100 k. w. power generator.

PATTISON BROS. have been retained by Carere & Hastings, the architects, as consulting engineers for the electrical work on the grand new Library Building, to cost several million dollars and to be erected on Fifth avenue and Bryant Park.

STATEN ISLAND.—A very broad franchise for subways and pretty well everything in the line of light and power has been asked for at New Brighton by M. Manzenado, E. Wisely, J. S. Warde, E. F. Mead, G. N. Whitney, H. P. Whitney, F. L. M. Masury, J. Irving, and G. Lynch.

EDISON ELECTRIC ILLUMINATING COMPANY, of Brooklyn, have declared their regular quarterly dividend of 1½ per cent. Earnings show a large increase.

J. P. WILLIAMS, New York, is issuing a handsomely designed calendar for 1898 advertising his Paragon fans and power motors. He has also just issued a descriptive catalogue, No. 3, which gives a concise and complete idea of his specialties. A copy will be mailed to any address on application.

MR. R. A. BYRNS, who has been associated with the New York office of the Walker Company, has now been put in charge of their Buffalo office at 912 Ellicott Square, where he will be glad to receive orders and inquiries.

COMMERCIAL CABLE pen wipers are the correct thing for the well appointed electrical desk. They have a pretty button of the company on top of a tricolored flannel pad, and have a neat calendar on the under side.

THE ELECTRICAL VEHICLE CO. has taken over the business of the Electric Carriage Co. in New York City, and will operate a charging station at 1680 Broadway, the former Michaux Bicycle Academy. Fifty new coupés and fifty new hansoms are being built. The company now has 14 cabs running.

MR. D. O. HAYNES, the well known publisher of the Pharmaceutical Era, has now turned his other property, the old Shipping and Commercial List, into the Daily Commercial, which will be connected on broad line with the vigor and intelligence that one always associates with any of Mr. Hayne's enterprises.

PATERSON, N. J.—One thousand laborers have been working night and day for the last two months, making a new channel for the Passaic river for a long stretch between Little Falls and Great Notch, in Passaic County. This is to secure for the East Jersey Water Co., it is said, power estimated as worth several million dollars. At the mouth of the channel it is planned to erect a mammoth electric power plant of from 15,000 to 20,000 horse power.

THE LIVERPOOL & LONDON & GLOBE INSURANCE CO.'S calendar for 1898 is 13 by 17 inches in size, and bears the company's name in white letters on a Venetian red background. The date characters are large enough to be read at a distance, and, as the moon's phases are noted, it may serve as an almanac as well.

NEW YORK CITY.—The Dry Dock, East Broadway & Battery Street Railway Co. is to operate four cars with chloride accumulators on the crosstown line between the Grand and Desbrosses street ferries. The test is to last six months. Mr. G. Herbert Condict will supervise the work.

WESTERN NOTES

COSMO ELECTRIC COMPANY report an unprecedented demand for their small telephone outfits. Mr. J. P. Brown, long and favorably known in telephone circles, is the expert of the company.

CHICAGO.—The Reliable Electrical Supply Company has dissolved by mutual consent, Otto Reiman agreeing to assume all the concern's obligations.

AHLM-EDWARDS ELECTRIC CO., of Cleveland, O., have made an assignment, with liabilities of $5,000 and assets rated at $9,000. W. J. Hart has been appointed assignee.

THE PACKARD TRANSFORMER is still holding its reputation for indestructibility. As now made, this transformer is so thoroughly insulated, the manufacturers say, that it seems almost impossible to burn it out. In only very rare cases has it been unable to withstand the severest lightning discharges. This immunity from burn-outs has made the Packard Transformer very popular, and the Electric Appliance Company are reaping the benefits of its popularity this fall in a very largely increased trade.

TOLEDO, O.—The Harrison Telephone Company has passed into the hands of a receiver, Daniel Morris being appointed by the court to manage the concern. The company's affairs are reported to have been in bad shape for some time and the excuse they give is that they couldn't do the business and give the service for the price. The company's liabilities will reach $20,000, while the assets consist of some 800 telephones in use.

CINCINNATI, O., is enforcing a rule that all arc lights outdoors must be at least 9 feet clear above the sidewalk.

CHICAGO, ILL.—Early use of electric power is looked for on the Evanston division of the Chicago, Milwaukee & St. Paul Railway.

KANSAS CITY, MO.—The Missouri and Kansas Telephone Company has spent $250,000 on conduits and next February will spend $100,000 more.

LIMA, O.—The Lima and Columbus Electric Railway Company, which is to build 40 miles of road this spring and is now taking up rights of way, is open to hear from contractors, dealers in bonds, etc. J. M. Boose, A. Fisher, D. H. Sullivan, and others are interested.

CINCINNATI, O.—"Prices on electrical supplies are advancing," says President Samuel Glover, of the Post-Glover Electrical Company. "Nearly everything is up to-day, and further sharp advances are probable. The cause? Well, I guess the dealers have gotten tired doing business and enjoying no profits. The time has come when dealings in electrical apparatus are greater in aggregate values than in the electric machinery. That branch of the business has come to be very much like the hardware business, due, of course, to the large amount of electrical machinery now in use and the constant wearing out of small parts."

THE HIGHLAND ELECTRICAL SOLDERING PASTE is rapidly pushing itself to the front, as the only soldering flux to use where careful work is a requisite. Tests have shown that it gives an excellent joint that can be made with the least possible amount of solder and without any corrosion whatever. It

is now being used by telephone companies. The electric light companies also realize that it is important that every joint made on their lines should be a good joint, and are now using the Highland paste very extensively. The Electric Appliance Company, Chicago, are sending out a two-ounce box for 25 cents, which gives a good opportunity to test the paste, and is a supply which will last probably as long as one pound of soldering salt, and do far better work.

WM. H. McKINLOCK & W. C. CAMP, agents to the successors of the Metropolitan Electric Company, have taken a five story and basement building at 175 Randolph street, Chicago, where they will carry on the business of electrical supplies. Their increased facilities at this location promise better attention to their large list of customers. Those interested in electrical matters of any kind are invited to call and inspect the new store. The mammoth catalogue of the Metropolitan Electric Company will be available and the customers of this firm can use the catalogue numbers and trade words as usual.

MR. GEORGE M. CHANDLER, late of the Chandler & Taylor Company, of Indianapolis, has become associated with the Brownell Company, of Dayton, O., as a salesman, and as such will visit all his friends and acquaintances in the near future in the interests of their engines, boilers, saw mills, etc.

MR. JOHN T. McROY, 915 Chamber of Commerce Building, Chicago, sends us an excellent section of conduit which is made to serve perfectly the purpose of a fountain pen.

J. M. HOLLISTER, of the Western Electric Co., Chicago, has invented a new two and three-point flush incandescent switch, which is being put on the market.

THE ELECTRIC APPLIANCE CO. are congratulating themselves upon the great record that is being made by O. K. weatherproof wire. Although this wire has been on the market for about ten years, there is said to be not a single recorded case where the insulation has not given the very best of satisfaction. O. K. weatherproof insulation has never been known to come off of the wire, and wherever used the insulation is good and hard after five or ten years of service. With this insulation a line with the insulation hanging in shreds or strings is an impossibility, as the material is put on in such a way that it is next to impossible for it to strip off. It is deservedly popular, and is cheap.

WESTERN ELECTRIC CO. has been made exclusive agent for the Tuerk alternating current ceiling fan in the territory west of Pittsburg. It has also been made exclusive agent for the car heaters and office heating devices manufactured by the Globe Heating Company.

WARREN ELECTRIC & SPECIALTY CO., manufacturers of high-grade anti-trust incandescent lamps, Warren, Ohio, advise us that they have entirely recovered from the effects of the fire which partially consumed their laboratory on Nov. 18 last, and are now ready to fill orders promptly, and offer apologies to any customer, the shipment of whose order has been delayed by reason of the fire.

ST. LOUIS, MO.—The street railroad managers are having a troublesome time over vestibules for motormen on the winter cars.

NEW ENGLAND NOTES

L. I. FLETCHER & CO. has been organized at Portland, Me., to deal in electrical machinery and goods. The capital stock is $25,000. The officers are: President, Lewis I. Fletcher, of Lowell, Mass.; G. E. Grant, of Boston, treasurer.

HARRIMAN ELECTRIC SPECIALTY CO. has been organized at Hartford, Conn., with a capital stock of $5,000, by T. J. Burke, F. H. Harriman, F. H. Cunliffe and H. W. Fox.

THE MONSON-BURMAH SLATE CO., Portland, Me., report heavy and constantly increasing sales in their electrical slate. They are making a specialty of manufacturing this material for use in switchboards, bases, fuse blocks, etc., and tne material is giving eminent satisfaction wherever used. They have facilities for manufacturing in large quantities and make a specialty of very prompt deliveries which is a factor to be considered in ordering slate. Their plain, unpolished slate is in great demand, as well as their black polished and marbleized.

AMERICAN ELECTRICAL WORKS, Providence, R. I., report aggregate sales of wire and cable greater for October than any month in their history; and they have been selling a pile of it for a long time.

HARTFORD, CONN.—At a meeting of the directors of the Hartford Street Railway Co. it was voted to increase the capital stock of the corporation from $200,000 to $1,200,000. This increase will be made, by the issue of $200,000 at a time, in January, April, July and October, which stockholders will receive at par, and by the issue on January 1 to stockholders of 5 per cent. debentures, equal in amount to the stock which they hold and exchangeable into new stock at the end of three years. It was also voted at the meeting to lease the East Hartford and Glastonbury road for a term of 30 years.

DAVIS ELECTRICAL WORKS, Springfield, Mass., have issued a very novel Christmas remembrance in the shape of an incandescent lamp filled with choice whisky. The cap is in the form of a cork, which carries a filament of glass, the whole thing making a souvenir worth keeping, even after the concern's health has been drunk.

BOSTON FIRE ALARM.—Mr. D. J. Buckley, electrical worker, has written to the Boston Herald making some definite complaints in regard to alleged mismanagement and shortcomings of the fire alarm telegraph service.

MR. L. B. STOWE, manager of the Burlington, Vt., district of the New England Telephone Co., has been appointed assistant to the superintendent of the Western division, with headquarters at Springfield, Mass. He is succeeded by Mr. J. Taylor.

SOUTHERN NOTES

THE NATIONAL AUTOMATIC FIRE ALARM CO., 618 Gravier street, New Orleans, are showing their patriotism in the color of the lead pencils they are distributing gratuitously. These pencils are triangular in shape and bear respectively on their three sides the colors, red, white and blue. One side bears the words, "Compliments National Automatic Fire Alarm Company, of La." On another side are their telephone number, their address and the words, "Electrical Supplies." This company are also distributing circulars of the Ericsson Swedish Telephone Instruments, including wall, desk and interior sets and coal grain micro-telephone.

BALTIMORE, MD., is discussing the construction of subways for wires under an electrical commission.

BALTIMORE, MD.—John E. Searles, secretary and treasurer of the American Sugar Refining Company, has purchased the Columbia & Maryland Railway. As a guarantee of good faith he is said to have deposited $3,000,000 with the Maryland Trust Company, of Baltimore, Md. The Columbia & Maryland Railroad Company was incorporated in 1892 to build a double track trolley line from Washington, D. C., to Baltimore, a distance of 38 miles. The road was completed on May 15 last, having 88.40 miles of track in all. Mr. Searles is member of a syndicate for this operation.

OTTO GAS ENGINE CO. have just installed two 120 h. p. engines for running electric lights at Sisterville, W. Va., and two 50 h. p. engines at Mannington, W. Va., for the same purpose. They report business as good.

LONG DISTANCE TELEPHONES are said to be used extensively by members of the McKinley cabinet and other leading government officials.

BALTIMORE, MD., has a subway struggle on hand, and various propositions are before the city authorities.

RICHMOND, VA.—The Virginia Electric Co. has just been granted a franchise for power transmission, and will, it is said, spend $1,500,000 in developing electrically the power of the James river for light and power in the city. The franchise is to run for 30 years.

PHILADELPHIA NOTES

THE ELECTROZONE COMMERCIAL CO., of Philadelphia, has been formed with a capital stock of $600,000, to make and use electrozone under the patents of Mr. A. E. Woolf. Meditrina, the concentrated form, will also be made. The company has a factory in Philadelphia and proposes to devote its attention to the introduction of municipal plants for purification of drainage, etc.

PAUL W. BOSSART, formerly secretary of the American Electric Telephone Company, has accepted the position of general manager of the Pennsylvania Electric Company, of Philadelphia, manufacturers of magneto bells, receivers and telephone accessories. Their factory is at Marietta, Pa. Mr. Bossart's many friends in Chicago will be sorry to learn of his departure to the Quaker City.

G. W. LORD, Philadelphia, is issuing literature on the subjects of water pollution and boiler incrustation. He does this as one way of pushing Lord's boiler compounds.

WESTINGHOUSE ELECTRIC & MFG. CO. has declared a quarterly dividend of 1¾ per cent. on its preferred stock.

THE CARNEGIE STEEL COMPANY, LIMITED, have recently contracted with James Bonar & Company, Pittsburg,

Pa., for 22,500 h. p. Pittsburg feed water heaters and purifiers. 6,000 h. p. will be placed at their Lucy furnace department; 16,500 h. p. will be put in at their Homestead steel works, as follows: 8,000 h. p. in the new 38 inch blooming mill, one 4,000 h. p. each in the 35 inch and 40 inch mills, and 500 h. p. in the open hearth department. This is probably the largest month's business ever placed by one concern for feed water heaters and purifiers.

A NOVEL TIME REGULATOR is proposed in Philadelphia. in the shape of the electric lights around the William Penn statue on the City Hall. The idea is to flash the 16 arcs in correspondence with the hours. The lamps are 460 feet above the sidewalks.

FOREIGN NOTES

THE NORWEGIAN MICA CO. inform us that they have opened offices in Christiania, Norway. The company is working mica mines in Norway. The board of directors are the professor of mineralogy at the University of Christiana, Johan H. L. Vogt, and the civil engineer in Christiana, Mr. Henry E. Mohn, the latter as president.

QUEEN VICTORIA has granted a royal warrant to the Electrical Power and Storage Co., of London, as makers of storage batteries to Her Majesty. This is said to be a unique favor to an electrical concern.

COAST LINE SIGNALING.

Owing to objections raised by the Treasury Department, the Navy Department has been compelled to abandon its plan of utilizing life-saving stations in the operation of the proposed coast line signal system. The principal light houses along the Atlantic coast will be requested to manage the semaphores and other signal appliances and to receive and transmit messages between ships at sea and the Navy Department. The department is now installing the necessary appliances along the coast, and has received assurances of the active support of the naval militia of New York, Massachusetts and other States. New telephone and telegraph lines will be constructed, and where the telephones of the life-saving stations can be used the navy will ask the Treasury Department for permission to send messages over the wires. The whole seaboard will be included in one general scheme of coast line signaling, operated jointly by the naval militia and the light house service, under the direction of inspectors from the navy.

COST OF HAULING FREIGHT ON THE B. & O.

A record has been kept since June 30 last of train haul per ton per mile on the Baltimore & Ohio Railroad to determine results from the enormous sums paid for new and improved locomotives. The results have been more than gratifying to the management. Before new locomotives were purchased, before track improvements were made, and before the tonnage system of loading trains was adopted, the average train haul per ton per mile on the road was less than 225 tons, and some old employés think it did not exceed 200 tons. There are no figures for comparison, but in July the average was 334.76, in August 356.41, and in September, 361.4, a large and satisfactory increase. The average would have been still larger but for the fact that on several divisions, depending on coal for tonnage, little or no coal was moved, owing to the strike.

TURRETS OPERATED BY ELECTRICITY.

Secretary Long has accepted the proposition of the Union Iron Works, San Francisco, to install a central electrical plant on the battleship Wisconsin, now building there, of the same character and at practically the same terms as those recently authorized on the Alabama and the Illinois. This will cost $11,400, which includes an extra $900 for freight to the Pacific coast, in addition to the amount allowed to the Cramps and Newport News companies.

The electrical installation will operate the turrets and ammunition hoists of these ships, doing away with steam pipes, with their attendant nuisances.

WEST POINT, MISS.—The city of West Point has about concluded to add an electric light plant to its water works, and would be glad to get prices on electrical machinery. Address W. W. Robinson, at that place.

WESTERN UNION WIRES IN THE NORTHWEST.

Work on the new Western Union telegraph line from Seattle to Victoria will begin at once. The estimated cost of the new line is $250,000. Two large copper wires will run from Seattle to Port Angeles, and thirty miles of cable containing three conductors from Port Angeles to Victoria. One new copper wire will also be strung from Seattle direct to Port Angeles. In addition there will be a branch loop between Seattle and Vancouver. With these new lines there will be no difficulty in handling all the news from the Klondike next spring.

P. R. WAGOR & CO., 275-9 Main street, Springfield, Mass., makers of lamp guards and other wire specialties, say that they are in receipt of a letter from the largest electrical supply house in the United States, which says: "We must admit that the guards made by you are superior to any in the market." Wagor & Co. complain of irresponsible imitation and of infringement of their patent, No. 502,458, on the "Acme" guard. They report that their guard trade last year was something remarkable, far beyond anything they had anticipated, and opening up with good promise for the new year.

CONTENTS.

Department News Items will be found in advertising pages.

CLEV.-LORAIN HIGH SPEED ELEC. R. R.—WITH DATA SHEET SUPPLEMENT.

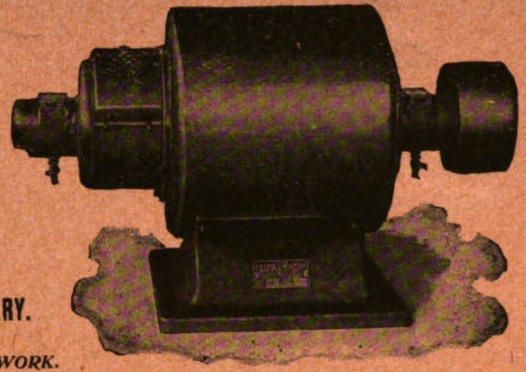
Electrical Engineer.

A WEEKLY REVIEW OF THEORETICAL AND APPLIED ELECTRICITY.
(Copyright 1897, by THE ELECTRICAL ENGINEER, 120 Liberty Street, New York.)

Vol. XXIV. No. 493. NEW YORK, OCTOBER 14, 1897. Price 10 Cents.

THE

STOREY MOTORS



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SPECIAL DIRECT CURRENT MOTORS FOR ALL CLASSES OF WORK.

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Manufacturers and Electrical Engineers,

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HIGH GRADE POWER AND LIGHTING MACHINERY, COMPLETE EQUIPMENT OF FACTORIES WITH ELECTRIC POWER.

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For all Purposes.
Scrap and Native Platinum Purchased.
BAKER & CO., 408-414 New Jersey Railroad Ave., Newark, N. J.

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IN ANY SHAPE OR PATTERN.

MICA SEGMENTS WASHERS AND RINGS.
DROP FORGE COPPER SEGMENTS.
MINERS AND IMPORTERS
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INSULATING CLOTHS AND PAPERS.
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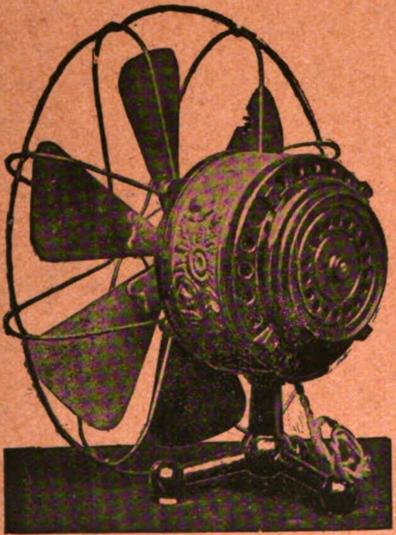
MICANITE
INSULATOR



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Direct Current Dynamos and Motors. Alternating Current Dynamos, Motors, Transformers and Arc Lamps. Motors for Single, Two and Three Phase Systems.

THE ... LATEST

The Scott & Janney Single Phase Alternating Railway System.

The only system ever invented which has many advantages over both direct current and Polyphase alternating systems. The motors are light, powerful, and are positively load starting, will operate at any speed. Heavier torque than best direct current motors. No commutators. Perfect rotary fields, which do not depend upon frequency at any speed.

Do not buy any alternating **DESK OR CEILING FANS** until you have seen ours. The **BEST** ceiling fans on earth. No commutators or brushes, no sparking and dissatisfaction, economical in every sense. Write us for full particulars.

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Battery Cylinders, Telephone Transmitter Carbons, Carbon Brushes and Electric Light Carbons.

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ALL KINDS PRICES OF PARTS TELEPHONES
ELECTRICAL SUPPLIES
SEND STAMP FOR CATALOGUE. MIANUS ELECTRIC CO. MIANUS, CONN.

The Worthington Self-Cooling Condenser

...PRODUCES VACUUM without natural water supply. Requires no more water than that used to feed the boilers. Results guaranteed. Send for special catalogue.

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WIRE OR SHEET FOR ALL USES.
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16th Convention, A. S. R. A., Headquarters: International Hotel. Exhibit: Convention Hall, Niagara Falls

ALPHABETICAL INDEX TO ADVERTISEMENTS.

FOR CLASSIFIED INDEX SEE NEXT PAGE.

CLASSIFIED INDEX TO ADVERTISEMENTS.

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They are of known worth. They are beyond question. For eighteen long years they have been piling up their now unrivaled reputation for doing the best possible work, under the hardest known conditions.

They are to-day an absolutely known quantity, and we sell them exclusively on their daily recorded achievements in hundreds of engine rooms.

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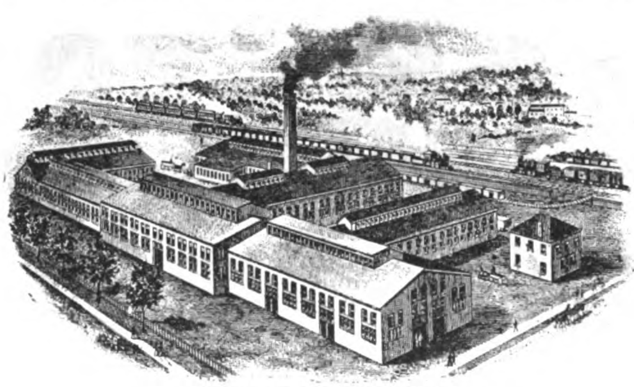

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This shows the BUSY WORKS, equipped throughout with a modern and efficient ELECTRIC POWER TRANSMISSION SYSTEM which is now being run NIGHT and DAY with a considerably increased force in an effort to keep pace with our rapidly multiplying orders for the celebrated

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Investigate the LATEST PRODUCTION in their line—THE PERFECTION OF DYNAMO DESIGN and CONSTRUCTION—Our NEW TYPE of MULTIPOLAR DYNAMO.

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PITTSBURG, 37 Vandegrift Bldg.
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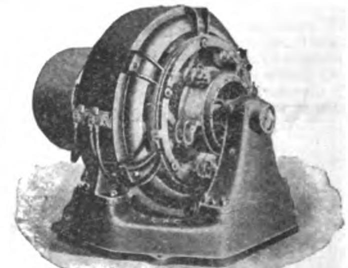

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Ceiling Fans and Exhaust Wheels

Wound for any Current except Alternating....

Our Exhaust Wheel

Combinations are the most compact and efficient of any made....

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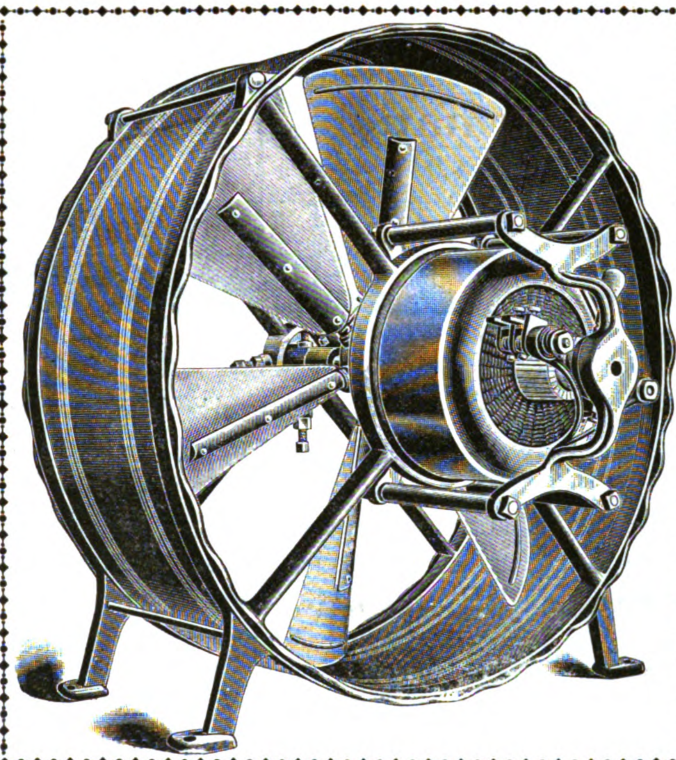

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WOUND FOR 110, 220 or in series on 500 volts. Also for Primary or Secondary Battery Circuits.

Highest Efficiency.

Unbroken Magnetic Circuit.
Self-Aligning Bronze Bearings.
Finest Insulation Throughout.
Four-Speed Regulator.

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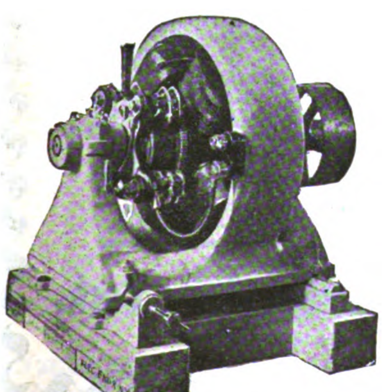

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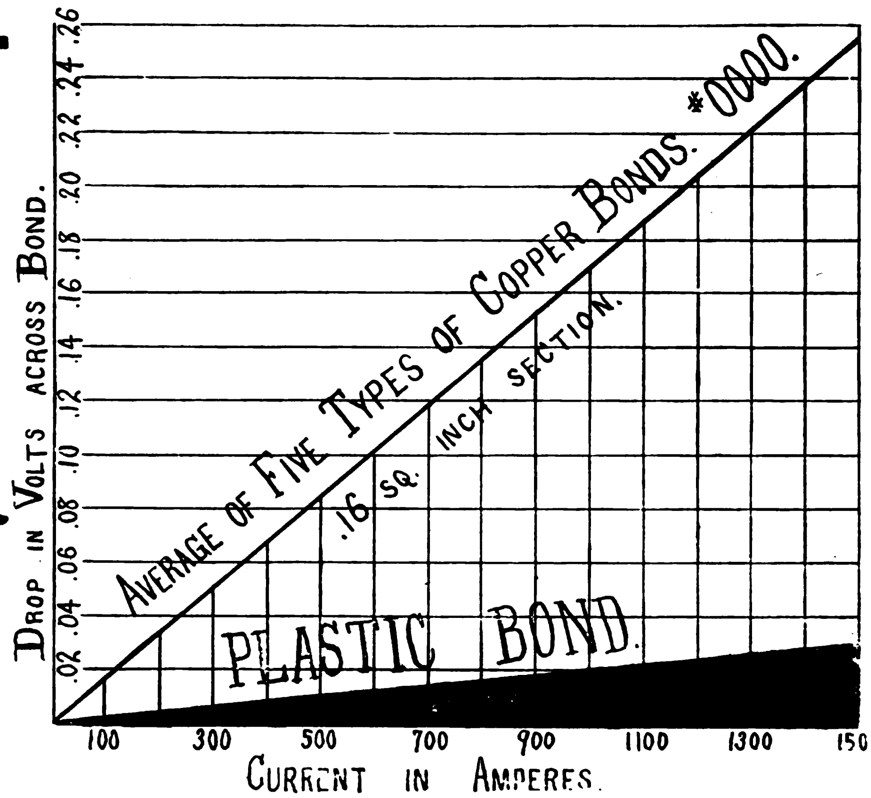

This Chart tells its story quickly to the Practical Electric Railway Manager and Engineer.

The **BLACK TRIANGLE** shows power absorbed by the **PLASTIC BOND** in transmitting current up to full conductivity of the rail. The **WHITE TRIANGLE** shows **POWER WASTED** by the Best Types of Copper Bonds when new.

The Copper Bonds were laboratory tests under best conditions. The Plastic Bond Tests were made when new and also after two years' Constant Service under severe conditions and show **NO DEPRECIATION.** Read this letter.

Extract from REPORT OF TESTS OF PLASTIC RAIL BONDS on the Hamilton Radial Electric Railway, Hamilton, Ont.

"Length of track, 9¼ miles; single track. Rail, 60 lb. T (second hand and badly worn; angle plates and fish plates also second hand). Power house situated at distant end of line.

"We found a large number of joints where the fish plates were very loose and we were considerably surprised to find that the electrical connections were so nearly perfect. We would advise that the fish plates be tightened up immediately.

"We connected one end of private telephone line to the track at the city and the other end at the power house to the positive terminal of our voltmeter, the negative terminal being connected to the negative bus bar. Then we had a car start from the city end while one of us took readings from the station ammeter, and the other took simultaneous readings from the voltmeter.

"We found that when the car was taking 60 amperes the drop in the track was 15 volts.

"With a current of 60 amperes the drop would be 12 volts if the rails were continuous or if the joints had the same conductivity as the rail. We found by actual test that the drop in the track was only 15 volts with a current of 60 amperes. THIS SHOWS A LOSS OF 3 VOLTS, WHICH WOULD BE NEARLY MADE UP BY THE FEW LOOSE JOINTS REFERRED TO BEFORE."

(Signed) WM. W. DEAN, Electrician Hamilton Street Ry.
C. K. GREEN, Genl. Supt. Hamilton, Grimsby & Beamsville Electric Ry.

The Government Tramway Engineer for New South Wales gives similar testimony, and the leading European Engineers follow suit.

As a result of these records the Plastic Bond is required for the CENTRAL LONDON UNDERGROUND, for the DUBLIN TRAMWAYS, the BLACKPOOL TRAMWAYS and the other most important European tramway work.

THE PLASTIC BOND IS THE ONLY BOND GUARANTEED FOR A TERM OF YEARS.

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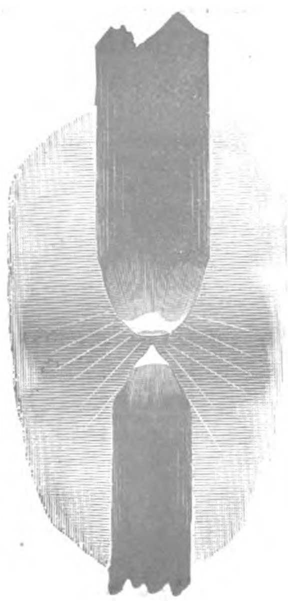

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FOR DIRECT AND ......
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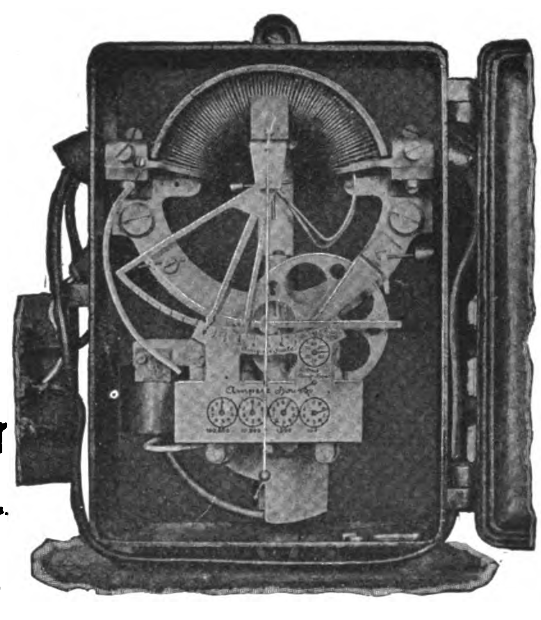

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Electric Freight and Passenger Elevator

"Will meet the most exacting conditions" of "Speed, Load and Rise," on either "Direct, Alternating or Phase Circuits."

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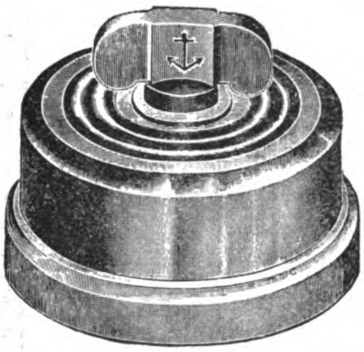

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100 HOURS

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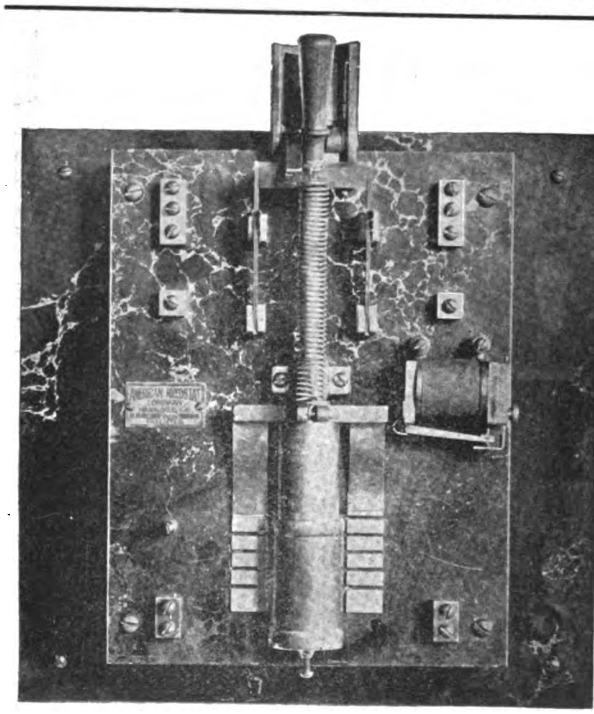

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Write for Circulars and Prices.

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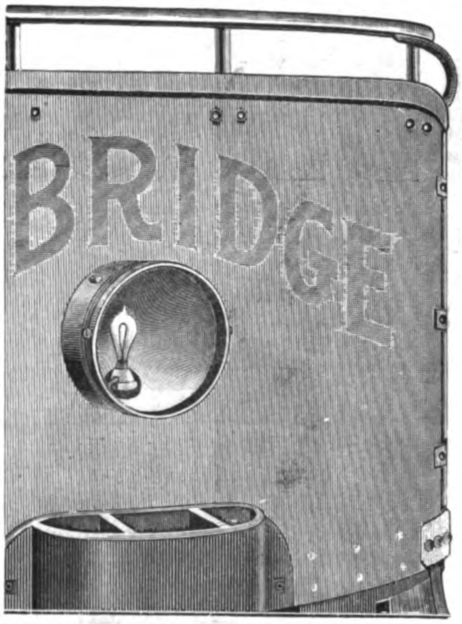

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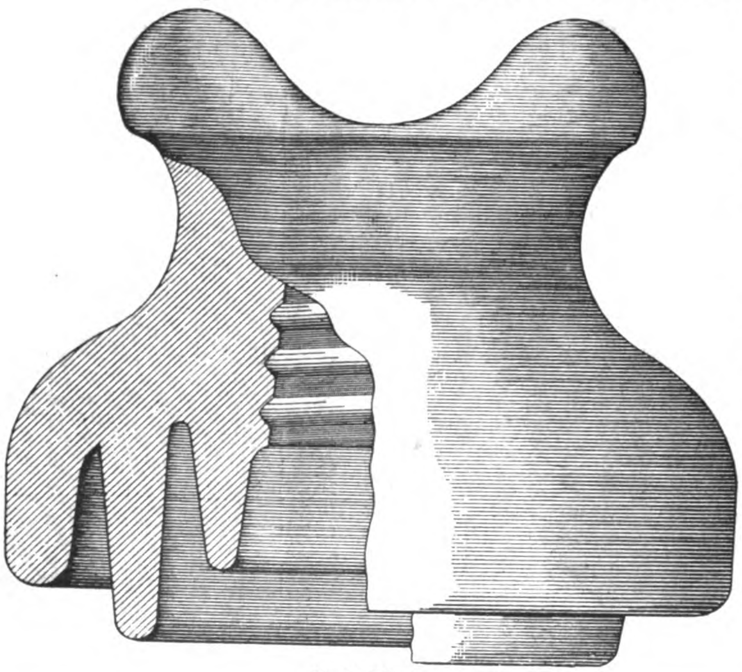
High Potential Insulators of all Kinds and Sizes.



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This Insulator is made of very strong Porcelain, and designed for heavy work as well as the Highest Insulation.

The Steel Pin is also designed for heavy work, and will pay those desiring a strong safe line that lasts as long as the poles stand to try them.

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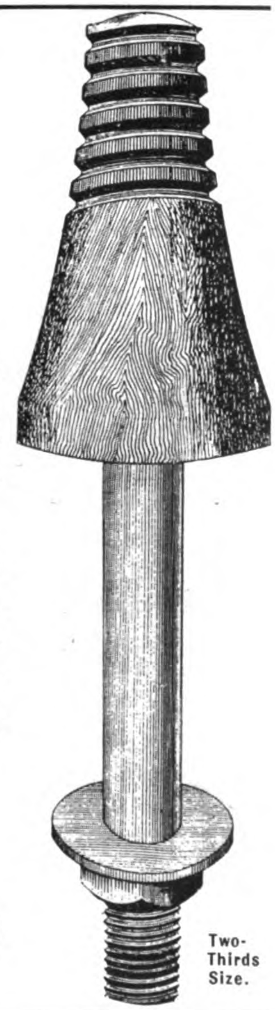

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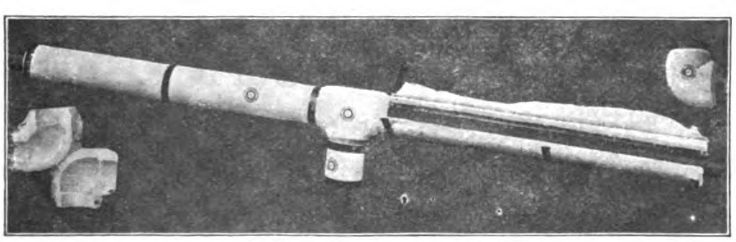

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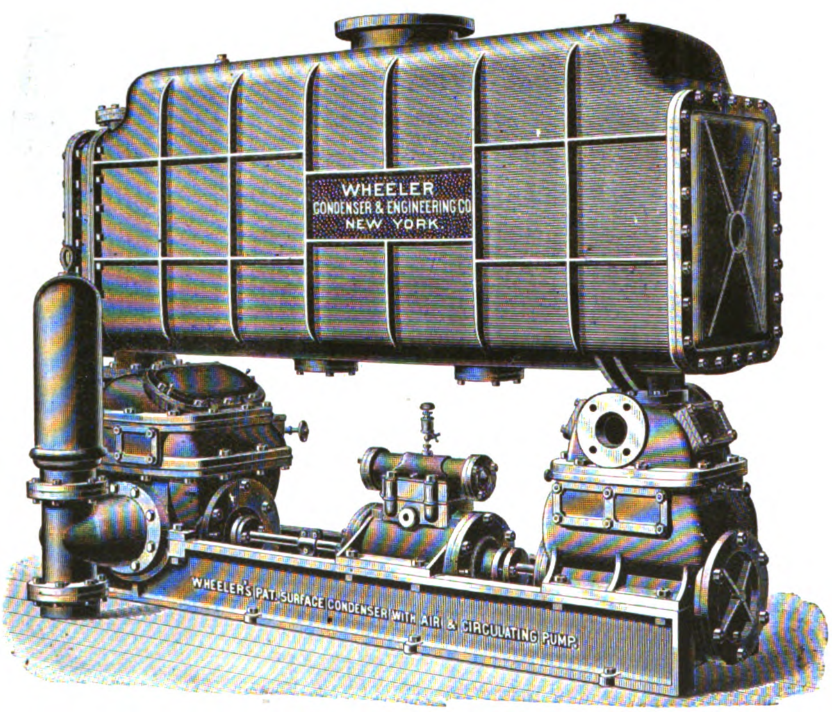

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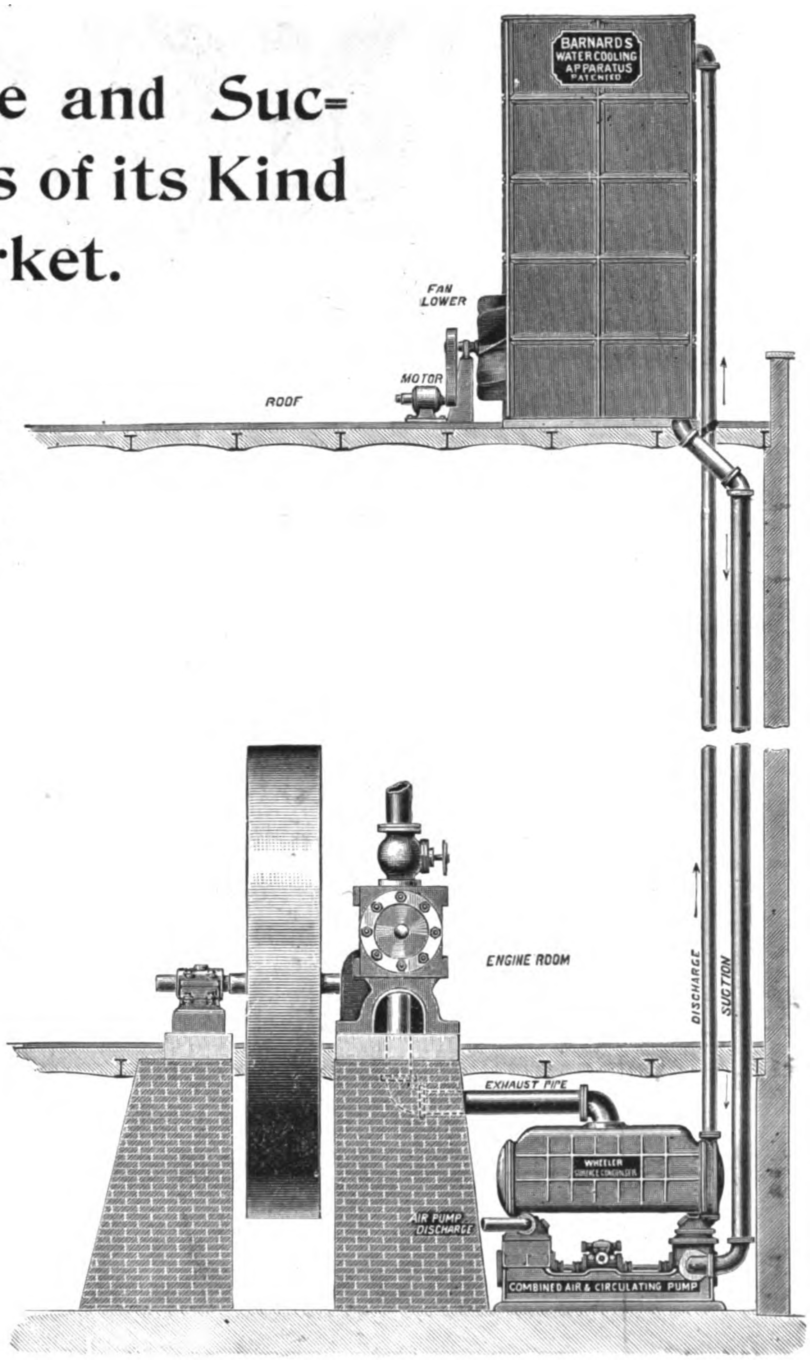

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Combines the most simple and effective method of operating steam plants condensing without a natural supply of circulating water.

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OF NOT LESS THAN

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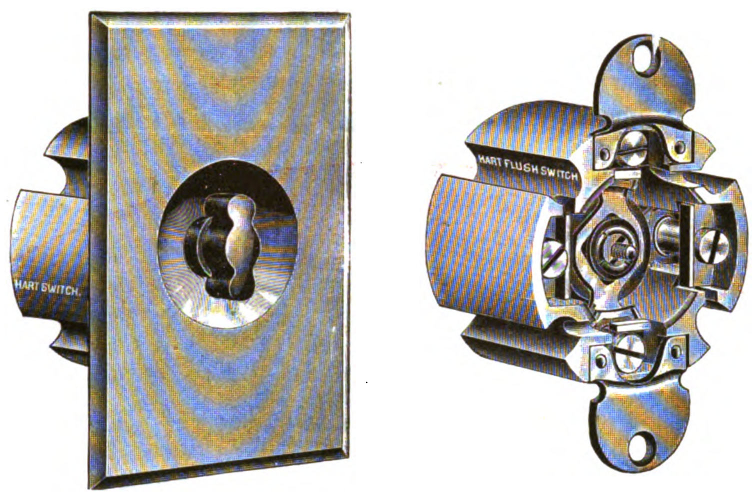

COMPLETE WITH PLATE. WITH PLATE REMOVED.

A HART FLUSH SWITCH,

first in design, workmanship and quality of material employed. They are made for service. Every Switch has the words "Hart Switch" stamped on the metal, and is guaranteed in every respect. Many experienced Central Station men, Contractors and Consulting Engineers use our Switches exclusively. A switch has more work to do than any other portion of a circuit, and there is more depending upon it.

A poor switch is dear at any price—it is a constant source of danger, annoyance and expense. Hart Switches are not only the **Best**—they are the **Cheapest.** Our illustrated Catalogue, Prices, and any desired information will be cheerfully furnished upon application.

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THE IRON ARMORED CONDUIT SYSTEM

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INTERIOR CONDUIT AND INSULATION COMPANY,

IS THE ONLY STANDARD.

WE OFFER THE ONLY COMPLETE SYSTEM OF ELECTRIC WIRING.

Our Standard Iron Armored Insulating Conduit

is far superior to any ever placed upon the market. Like all other Standards, this material will be imitated. However, the broad fundamental patents covering our process of manufacture prevent even a near approach to the features wherein lie the strength and integrity of insulation possessed by our

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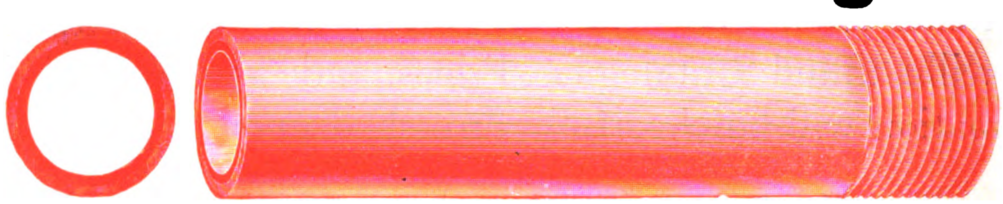

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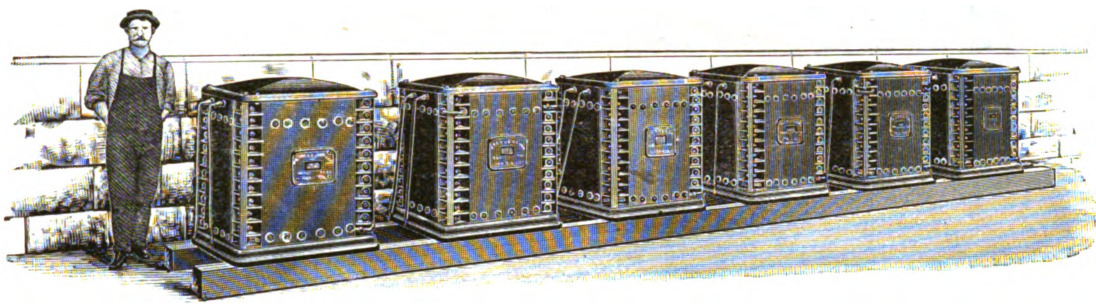
Step Up and Step Down Transformers for Long Distance Power Transmission Systems.

Voltage ratios, size of units, and general specifications in point of efficiency, iron loss and regulation adapted to the requirements of the installation. We are prepared to compete on the merits of the apparatus for equipments of any and all magnitudes, guaranteeing results. Self-cooling, air-blast or water-jacketed system installed at the selection of purchaser. Such Transformers in successful service in many important equipments.



600 K. W. 10,000 Volts Water-Jacketed Transformers as Installed at Riverside, Cal.

All kinds of Transformers for every kind of work. ***Secure our Latest Transformer Prices.***

WRITE FOR FULL INFORMATION.

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THE USE OF GARTON LIGHTNING ARRESTERS SEEMS CONTAGIOUS, LIKE

YELLOW FEVER!

AMONGST THOSE CONCERNS "STRICKEN WITH THE MALADY" MAY BE MENTIONED:

THE LORAIN & CLEVELAND RAILWAY.

See description of the plant in this issue.

AKRON, BEDFORD & CLEVELAND RAILWAY.

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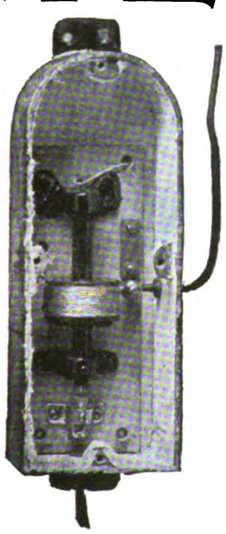
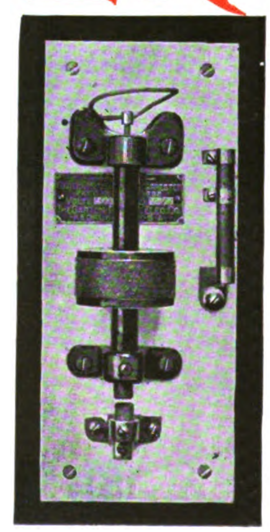
THE AKRON STREET RAILWAY & ILLUMINATING CO.

AND MANY OTHERS IN AND AROUND CLEVELAND.



Pole Arrester of either Railway or M. C. Type, showing Iron Case with cover removed.



Street Railway Station Type on base of White Italian Marble.

AND THE CONTAGION IS RAPIDLY SPREADING.

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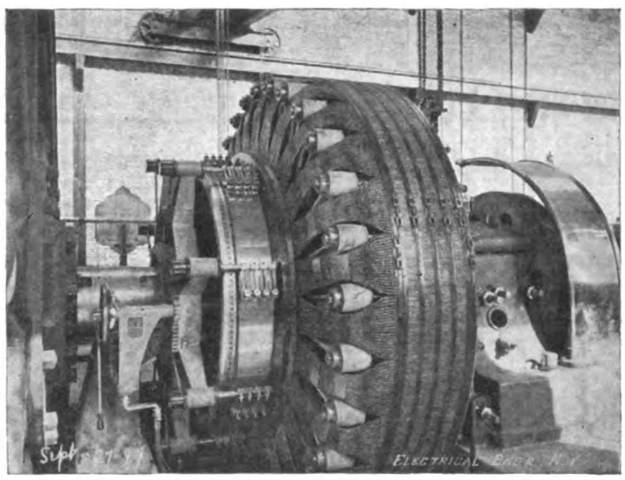

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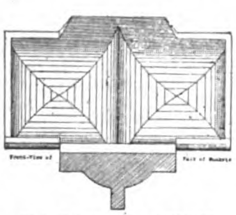

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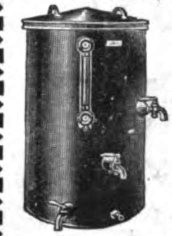

actually reduces oil bills 50 per cent. or more. Sent on approval. Capacities ranging from 3 to 120 gals. per day. Used in 14 countries. It is specially adapted to Electric Light and Power Plants. Our specialty is Oil Filters, of which we are the largest manufacturers in the world. Established 7 successful years. We equip complete filtering systems when desired.
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FRANKLIN H. KALBFLEISCH CO.
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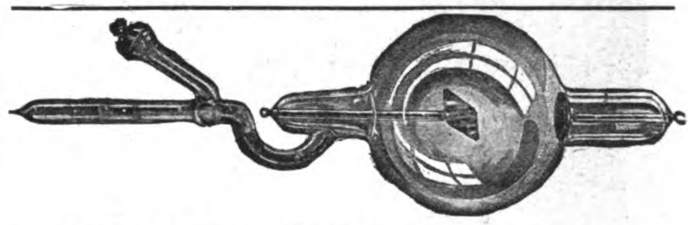
CHICAGO INSULATED WIRE COMPANY.
152-154 LAKE ST., CHICAGO.



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NEW X-RAY TUBE *With Automatic Vacuum Regulator.*

NO MORE TROUBLES FROM HIGH VACUUM TUBES.

Simple and Efficient. Keeps Vacuum Adjusted Automatically. Cannot Run Too High in Vacuum for Operation. Life Practically Unlimited.

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50 CENTS PER STICK.
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The only article that will **prevent sparking.** Will keep the Commutator in good condition, and **prevent cutting. Absolutely will not gum the brushes.**

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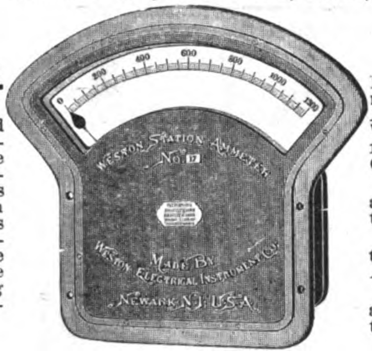
Illuminated Dial Station Instruments.

These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct Current Voltmeters and Ammeters, but are much larger, and the working parts are inclosed in a neatly designed dust-proof cast-iron case which effectively shields the instrument from disturbing influences of external magnetic fields.



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Portable Direct Reading Voltmeters and Millivoltmeters, Ammeters and Milammeters, **Wattmeters** and **Voltmeters** for **Alternaitng** and Direct Current Circuits.

Our PORTABLE INSTRUMENTS are recognized as standards throughout the civilized world.

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They are the most reliable, absolute standards for Laboratory use.

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Mention THE ELECTRICAL ENGINEER when writing for catalogues.

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GENTLEMEN: In regard to your Type C Governor, which is regulating for us our two Hercules Wheels, which give power to operate our Light Plant, Street R. R. and Power Generator, we ar frank to admit that the machine does its work admirably.

We have no hesitancy in recommending it to those in want of a governor.

(Signed) I. C. LIBBY, President Waterville & Fairfield R. R. & L. Co

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40 No. 17 Brush Arc lamps, 2,000 c. p., new.
30 Western Electric Double.
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40 Fort Wayne Double.
50 Double T.-H. M2 and M12.
100 Double T.-H. M2 and M12. Nearly new.
1 M. D. Machine, new ring armature.
7 750 light Westinghouse alternators, with equipments and exciters.
1 60 K. W. latest type Westinghouse alternator, exciter and station equipment, 1,000 volts, 7,200 alternations.
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Several reconstructed 60 K. W. Westinghouse alternators, toothed armatures, very, very cheap.
1 60 K. W. Wood, very cheap.
1 300 K. W. General Electric, 3-phase transmission plant. Complete step-up and step-down transformers. Also generator and motor, LESS THAN COST TO MANUFACTURE.
A lot of T.-H. "F." Oil type and Westinghouse transformers.
A lot of Westinghouse new converters of the latest make.
A large lot of Stanley transformers, from ten lights up of the latest type. Secondaries convertible 52 and 104 volts.
3 W. P. 50 motors, very cheap.
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Incandescent Dynamos from 25 light to 1,000 light, all sizes.
Motors, 110, 220 and 500 volt, from ¼ H. P. to 75 H. P.; largest stock in America.
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Electrician and superintendent to take full charge of fully equipped plant in the manufacture of dynamos, motors, etc.; one who will take a monied interest only need apply. Address

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1 150 light, 1200 C. P. Automatic Dynamo (New).
1 65 " " " " " "
1 100 " 2000 " " " (used 6 mos.)
1 70 " 800 " " " (used 9 mos.)
1 50 " 1200 " Dynamo, without regulator.
1 25 " 800 " " " "
125 new all-night arc lamps (latest style).
10 second-hand midnight lamps.
1 100 h. p. Phœnix engine.
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Position as superintendent or electrician of an electric railway. The writer has had an extensive experience in the construction and operation of electric roads, an expert armature winder and familiar with all types of railway apparatus. Am at present superintendent of a Western road, and can offer the best of references from present employers and others.
Address, **L. P.,**
Care of The Electrical Engineer,
120 Liberty street, New York.

ELECTRIC POWER.

NEW YORK CITY.—The Sprague Electric Elevator Company will put an elevator in the enlarged Harmonie Clubhouse, West Forty-second street.

LOS ANGELES, CAL.—The Lytle Creek Light and Power Co. has filed on 3,000 inches of water flowing in the middle fork of Lytle Creek, the water to be taken out about three-quarters of a mile above the wagon road in the canyon. It will be used in the company's power plant to generate electricity.

TELEPHONE.

PARIS, ILL.—The Eastern Illinois Telephone Company has completed their line to this city, and the same is now in working order. The line runs from Isabel to Paris and will in a short time be extended to Westfield.

BAY CITY, MICH.—The Valley Telephone Company's line to the Monitor coalfields has been completed and is the first line of the new company to go into operation. The line connects with the Monitor coal mine and in Bay City with the company's office. It is about five miles long.

TELLURIDE, UTAH.—O. C. Thomas and J. W. Burley have organized a telephone company to construct a public telephone system between Telluride and the Marshal and Savage basin mines, a distance of five miles.

ROSEVILLE, O. T.—The Roseville Telephone Company has been formed; capital stock, $5,000.

UTICA, N. Y.—The Utica Standard Telephone Company is erecting poles in this city, notwithstanding the fact that the Common Council rejected their application to have the franchise of the old Baxter Company, whose rights they hold, confirmed.

CONCORD, N. C.—The Concord Telephone Company has put in a board of 140 drop capacity and has 80 subscribers. The apparatus was made by the Telephone Manufacturing Company. It has 25 miles of line, and gets $10 a year for residences and $15 for stores. The exchange is in a room in the National Bank. The present capital is $1,500. The officers are N. F. Yorke, president; W. C. Houston, vice-president, and L. D. Coltraine, secretary and treasurer.

CEDAR RAPIDS, IA.—The annual meeting of the Cedar Rapids and Marion Telephone Co. has been held. The reports of the officers showed that the past year had been a most satisfactory one in every respect. This company now has 633 'phones in use. The following officers were elected for the ensuing year: President, George T. Hedges; vice-president, John Thomas; treasurer, Ed M. Scott; secretary, W. H. Durin.

MUSCOGEE, I. T.—This city is soon to have telephone connection with Galveston, Texas, and Kansas City, Mo. The poles are now on hand for the building of the line from here to Wagoner, I. T., and as soon as the line is completed to Wagoner it will be extended to Chetopa, Kan., and from here to South McAlester, I. T., making a continuous line from Kansas City to Galveston, Texas.

YONKERS, N. Y.—The Yonkers Railroad Company reports for the year ending June 30, 1897, a deficit after charges of $10,321. The balance sheet shows a profit and loss deficit of $11,484.

FREEPORT, L. I.—Articles of incorporation have been filed with the Secretary of State by the South Shore Telephone Co., of Freeport, Queens County. Its capital stock is placed at $2,000, consisting of shares of $25 each. It is proposed to build and operate a telephone line in the village of Freeport, to connect with similar lines in Hempstead village and other villages in Queens and Suffolk Counties. The directors of the company for the first year are George W. Bergen, Henry P. Libby, William D. Carter, Charles D. Smith, William G. Miller, John J. Randall and George P. Bergen, of Freeport.

See further, page xxxiii.

ELECTRIC RAILWAYS.

EXETER, ONT.—Local capitalists are promoting an electric road from Grand Bend to St. Mary's. The plan includes a station for the general distribution of power.

CHICAGO, ILL.—The M. F. Maline Company of Chicago has applied for a receiver for the Indianapolis, Anderson and Marion Electric Railroad Company, in process of construction. It is charged that work on the road has ceased, and the claim of the company against the road is thereby endangered, as the value of the franchises, etc., will be impaired. It is alleged the road has been insolvent since August, 1896.

BRADDOCK, PA.—The Covey Avenue Street Railway Company, capital stock $10,000, has been granted a charter to build a road in Braddock.

McKEESPORT, PA.—The Youghiogheny Traction Company has secured control of the lines of the Versailles Traction Company, between McKeesport and Boston Bridge for $85,000. The Versailles line is 3¼ miles long. The Youghiogheny Traction line will extend to Buena Vista and West Newton, making, with the Versailles line, a road 15 miles in length.

BIRMINGHAM, ALA.—Under the direction of Chief Electrical Engineer Harris, ten large cars have been wired and equipped for electricity, for use on the Ensley line.

See further, page xxxiv.

ELECTRIC RAILWAYS.

DOYLESTOWN, PA.—The Northeast Penn Traction Company's property, which was seized by the sheriff some time ago, has been sold to Louis P. Conwell, of Philadelphia, for $100. The execution against it was over $16,000.

PHILADELPHIA, PA.—The Attorney General has refused to allow a writ of quo warranto to issue against the Northwestern Passenger Railway Company of Philadelphia. The Union Traction Company recently applied to the Attorney General for a writ to revoke its rival's charter for alleged violation of law. The applicant waited to make out a case, and Mr. McCormick to-day gave a decision against the Union Company.

BROOKLYN, N. Y.—The Brooklyn Heights Railroad Company has completed plans for a new trolley line from Flatbush to Bath Beach. It will run through Avenues C and E, under the Ocean Parkway, and thence down Fifteenth or Sixteenth avenue to the bay.

MILWAUKEE, WIS.—The Milwaukee & Waukesha Electric Railway Co. wishes to amend its franchise which requires 10 miles of track to be laid by Oct. 20.

WORCESTER, MASS.—The Worcester Traction Company has declared the regular semi-annual dividend of 4 per cent. on its preferred stockholders, payable to stockholders of record September 20.

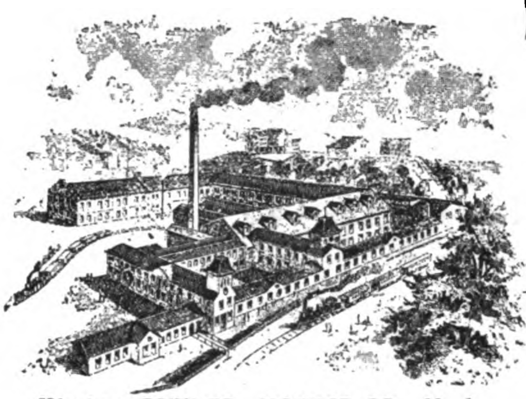
See further, page xxiv.

TELEGRAPH.

AKRON, O.—The Akron District Telegraph Company has been formed with a capital stock of $2,000.

OLYMPIA, WASH.—The Island Telephone and Telegraph Co. is making extensions of its lines in all parts of the Palouse country, and a large gang of men are engaged in stringing new wires along the old lines and putting in new lines. A new line has just ben completed from Pullman to Staley and Chambers. A new circuit has been added to the line from Moscow and a new copper circuit is now being added to the line from Pullman to Lewiston.

See further, page xxxix.



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PORTABLE VOLTMETERS FOR DIRECT AND ALTERNATING CURRENT CIRCUITS.

Direct Reading, Sensitive and Absolutely Accurate. Dead-Beat without the use of a Mechanical Brake.

**Mounted in Polished Mahogany Case.
Reversing Switch mounted on each Instrument.
All ranges from 12 volts to 700 volts in single or double scales, with or without multipliers.**

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STEAM ENGINES. STEAM LOOPS.
COMPLETE STEAM PLANTS. COMPLETE ELECTRICAL PLANTS.
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Records accurately all work done on Foot and Power Presses, Weighing, Measuring and Automatic Machines. Circular and Price List on application.

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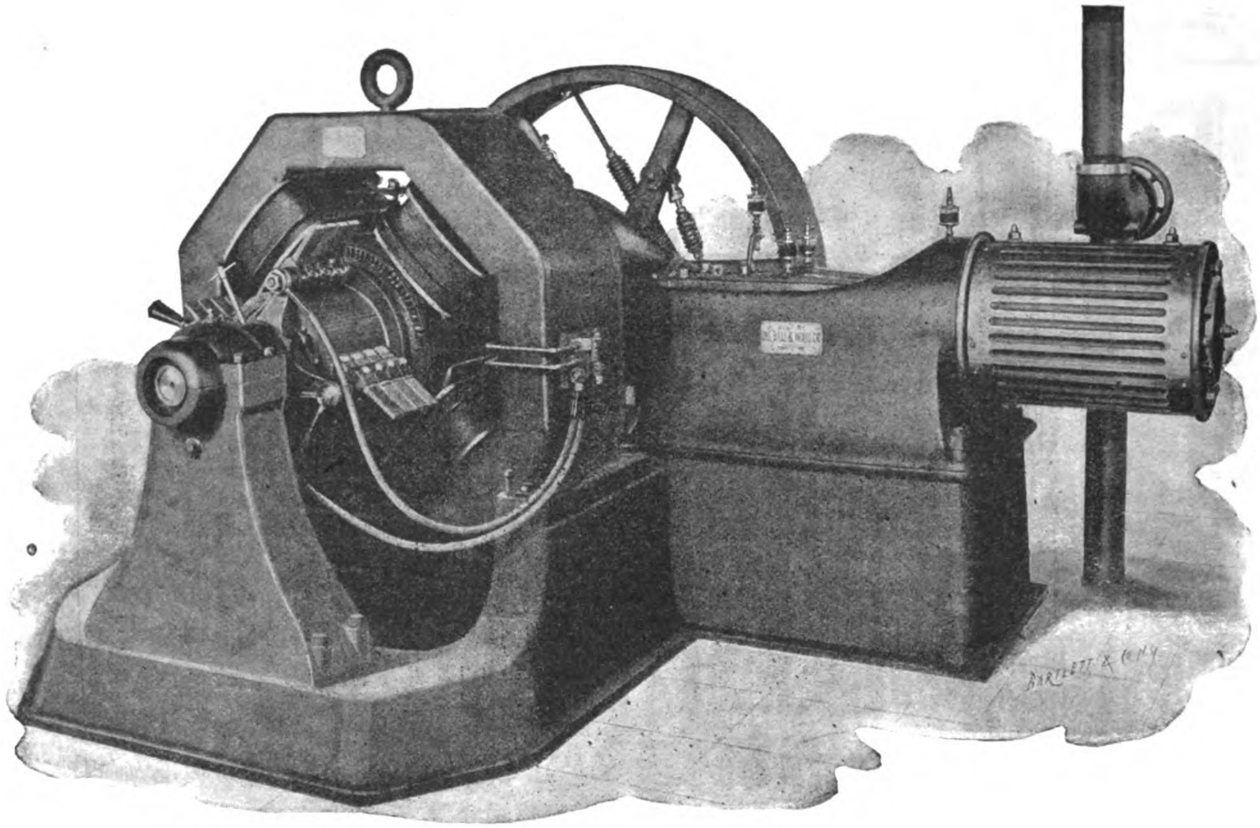
Eddy Generators

FOR POWER AND LIGHTING.

With bar-wound armatures, thoroughly insulated and ventilated. Accident remote.

Repairs easy. Perfect in operation. Highest in efficiency.



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STATIONARY MOTORS.

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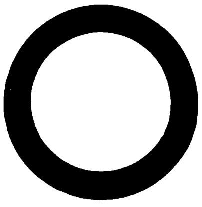
BOSTON: G. M. Angier & Co., 64 Federal Street.
ELMIRA: S. N. Blake.
CINCINNATI: John A. Stewart, Navada Bldg.
ST. LOUIS: Western Electric Supply Co.
KANSAS CITY: W. T. Osborn.
CHICAGO: Wallace & Hine, 305 Dearborn St.
SAN FRANCISCO: California Electrical Works, 409 Market Street.



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Made from best quality Soft Iron or Electrical Steel, in sizes from 3 to 14 inches diameter, with any size hole. Send for prices.

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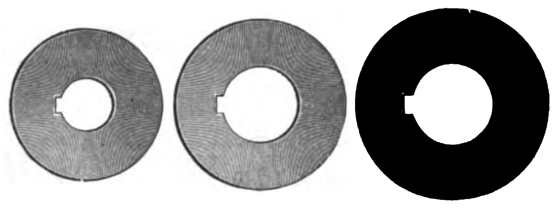
14 Cypress Street, **THOS. SMITH & CO.,** WORCESTER, MASS.



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TELEPHONES AND SWITCHBOARDS.

Largest Manufacturers of Telephone Apparatus, Exclusively, in the United States. The United States Patent Office Uses our Apparatus.

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Especially prepared for electrical work of all kinds, either Construction or Repair. Made from the purest materials obtainable. Will not harden in the bottles. Packed in half pound, one pound, and five pound bottles. Just the thing for dealers in electrical supplies to carry. If your dealer cannot supply you, write direct to us. Special discount on orders for quantity. **Samples sent Free of Charge on request.**

SAL AMMONIAC 99¾%

Manufactured expressly for electrical purposes. The quality of our Sal Ammoniac is equalled by that of few brands, and excelled by none. Packed in 200 pound barrels. **Samples sent Free of Charge on request.**

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TELEPHONE.

BOSTON, MASS.—The Erie Telegraph and Telephone Co. asks the stock exchange to list $1,000,000 additional collateral trust 5 per cent. gold debenture sinking fund bonds.

BOSTON, MASS.—The American Bell Telephone Co. will pay a dividend of $3 per share Oct. 15, 1897.

ELECTRIC RAILWAY.

LUBEC, ME.—The construction of an electric railway is in contemplation to run from Lubec to Machias through Whiting and East Machias, a distance of 28 miles.

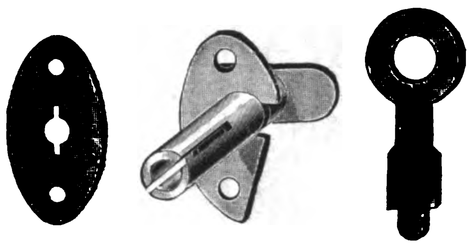
See further, page xlii.

No Extra Charge for the Data Sheets!!

The Up-to-Date "Electrical Engineer" Data Sheets.

SOME time ago The Electrical Engineer began the publication of digested information in the form of Data Sheets, under the editorship of Mr. Albert B. Herrick. We now append a list of the sheets that have appeared already. It will be seen that Mr. Herrick, with great ability and excellent judgment, has already brought together a most interesting and valuable mass of data, which, on account of the manner in which it is printed, and the method adopted for its preservation in filing cases, has added materially to the resources of the practicing engineer. A great many branches of the electrical art have been treated, but we may say that the matter already published is but a fraction of that in hand and now being made ready. The scheme adopted proves very flexible, so that it is easy to add new sheets or replace old ones with more recent data, as occasion arises. Engineering pocketbooks are useful, but these Data Sheets have the advantage of coming up to date, and of being ceaselessly added to and expanded. With regard to the coming year, Mr. Herrick has already made preparations for the publication of the subjoined Data Sheets, in their respective dresses. The value and importance of this information will be seen at a glance. Filing cases, cloth, 30 cents; Morocco, 60 cents. Every thoughtful engineer will be glad to have it in this handy form:

INDEX TO PUBLISHED DATA SHEETS.



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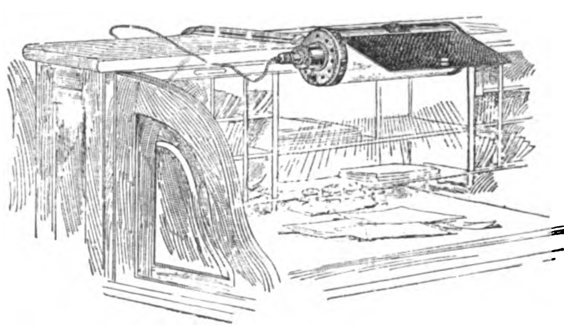

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ELECTRIC RAILWAYS.

CLEVELAND, O.—The Cleveland, Berea & Elyria Railroad Company has applied for a franchise to build a line from its Lorain street track to Linndale. It is proposed to complete this branch within a year.

TITUSVILLE, PA.—The Titusville Electric Traction Company has filed a bond for $2,500 as a guarantee to complete its lines in Titusville within one year from the date of accepting the franchise granted by the city.

CHICOPEE, MASS.—The city council has granted a franchise to the Holyoke Street Railway Company to extend its line on Chicopee street.

ST. PAUL, MINN.—An ordinance has been introduced in Council providing for the changing of the cable line on Selby avenue into an electric line. City Engineer L. W. Rundlett estimates cost of tunneling Shelby avenue hill at $91,000.

ATTLEBORO, MASS.—The Norton and Attleboro Street Railway Company has been incorporated, with a capital of $40,000. The treasurer is E. D. Hewins and the directors Franklin Mead, D. A. Brooks, A. H. Sweet, George L. Wetherell, George H. Lovejoy and G. P. Talbot. The line will run from the New York, New Haven and Hartford Railroad station in Attleboro to the Library square in Norton, five and one-half miles.

BROOKLYN, N. Y.—The Brooklyn Heights Railroad Company has filed its application with the Brooklyn Bridge trustees for the use of Liberty street, from Sands to Fulton street, for a double track road. The company also asks for the privilege of laying side tracks at the present bridge terminal.

BIRMINGHAM, ALA.—The Birmingham Railway and Electric Company, owners of the street car system of Birmingham, two suburban electric roads and one steam dummy line, have closed a deal for the purchase of the Birmingham, Powderly and Bessemer Steam Dummy Line, extending to Bessemer, fourteen miles, and a strong competitor of the electric company's road. The road will either be equipped with electricity and used as a loop in conjunction with the company's old Bessemer lines, or may be disposed of to some new trunk line that may seek admission to the city for terminal purposes.

LOS ANGELES, CAL.—There is a rumor that the Redondo Railway Company has about concluded arrangements to electrize their road and to build a branch to San Pedro.

PEORIA, ILL.—The incorporators of the Peoria and Pekin Traction Company, who are in the near future to construct and operate an electric street car line between the two cities, have held a meeting, and elected: President, Theodore J. Miller; vice-president, Eddens J. Darst; secretary, A. M. Hewes; treasurer and general manager, L. E. Myers.

WHITE PLAINS, N. Y.—A meeting of the directors of the New York, Elmsford & White Plains Trolley Co. has been called for Oct. 16, to consider a proposition to increase the capital stock of the company from $60,000 to $600,000.

PEORIA, ILL.—The Peoria & Pekin Traction Co. has begun work grading its private right of way.

DAYTON, O.—The much talked-of Dayton & Eaton electric road will be built, and the only thing to be settled upon now is the location of the power house. This, in all probability, will be stationed at West Alexandria, a town east of Eaton a few miles. Dr. J. E. Lowes, of Dayton, who is the president of the Richmond Light, Heat and Power Co., is the president of the line, and with the following other members of the company drove over the entire route last week: J. E. Feight, of Dayton; J. W. Estep and G. P. Rohen, of Cleveland; L. A. Scovey, of Chicago; O. D. Phase and G. E. Fisher, of Detroit; I. N. Bick, of Toledo.

DOYLESTOWN, PA.—A whole trolley road, or rather a contemplated one, known as the East Penn Traction Co. has been sold for the paltry sum of $100 to L. A. Conwell, of Philadelphia, who says the company will be reorganized and some parts of the railroad built. The road includes franchises from one end of the county to the other, beginning at Tonesdale, and by a circuitous route reaches and passes through Quakertown.

WORCESTER, MASS.—The officials of the Worcester & Blackstone Valley Street Railway Co. are again pressing the matter of the right to extend their road so as to connect with the Worcester & Suburban Street Railway at Central square, Millbury.

LOS ANGELES, CAL.—There is a well authenticated rumor that the Los Angeles Traction Co. is to immediately begin the construction of an extension from its present terminus at University to San Pedro, surveys having already been made and rights of way secured.

BENTON HARBOR, MICH.—The right of way for electric street railways on Main street that has been in litigation by the St. Joseph & Benton Harbor Co. was granted to Benton Harbor & Eastman Springs Street Railway Co. They have now torn up pavements and laid some track over the road in dispute, presumably to avoid injunctions that were certain to come.

SANDWICH, MICH.—The extension of the Sandwich, Windsor & Amhertsburg electric railway from the mineral springs in Sandwich to Chappel's has been completed, and the line opened for general traffic.

BANGOR, ME.—It is now reported that both Monroe and Exeter will be reached by electric railway next year—the former by a branch of the Bangor, Hampden & Winterport line, and the latter by a branch of the Penobscot Central from Kenduskeag, eight miles.

KANSAS CITY, MO.—The new trolley line on Prospect avenue running from 15th street to 31st street has been tested and the trial trip was a success.

ELECTRIC POWER.

VICTORIA, B. C.—The Victoria Power Co. has been incorporated, with a capital stock of $75,000, to install an electric power plant to supply light, heat or power in Victoria.

SAN JOSE, CAL.—The San Jose Power Co., the projector of the Rio Honda water-works, in the southeastern foothills of the county, has taken the first steps in constructing a large electric plant, similar to that at Folsom, for the dissemination of power in San Jose and vicinity. The cost of the proposed plant will be about $300,000, and the capital necessary is ready to carry out the scheme. C. W. Quilty, the president of the company, is also president of the San Jose Light and Power Co.

MEXICO CITY, MEX.—The contract has just been awarded at Mexico City for the electrical plant for the transmission of power from the Rincon Grande Falls, near Orizaba, to the three mills, Rio Blanco, Cerrilos and San Lorenzo, owned by the Compania Industrial de Orizaba. The capacity of the generating plant will be 2,000 h. p., and there will be delivered the necessary power for the complete electrical operation of these three mills. This power will be transmitted over a distance of about 10 kilometers.

CANON CITY, COLO.—The city council has granted a 25-year franchise to the Colorado Electric Co. on consideration that they begin operations at once on the construction of a power plant to cost not less than $100,000.

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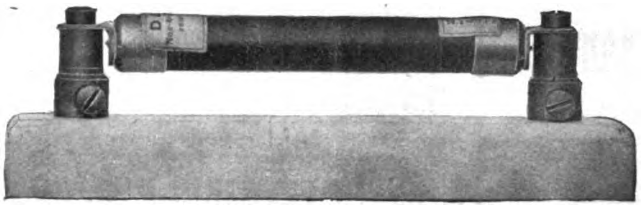

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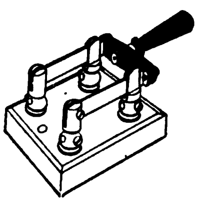

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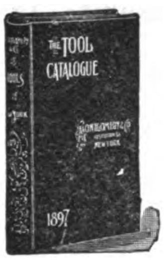

could justly be called an encyclopedia of tools: it is a book that every electrician or person interested in tools, supplies and machinery should have. The book is 10½ x 7¼ in., contains 710 pages and over 3,000 illustrations. It will be sent with linen cover on receipt of 35 cents, or a cloth binding, express paid, on receipt of $1.00. The money paid for catalogue is refunded with the first purchase amounting to over $10.00. Discount sheet is sent with each book.

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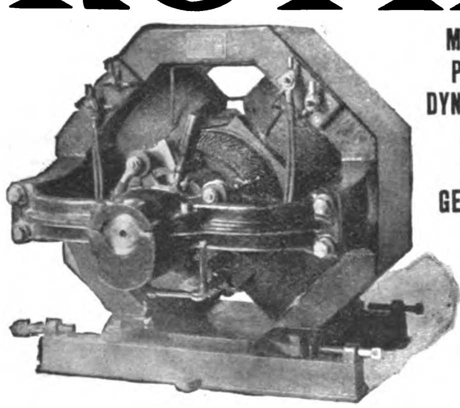

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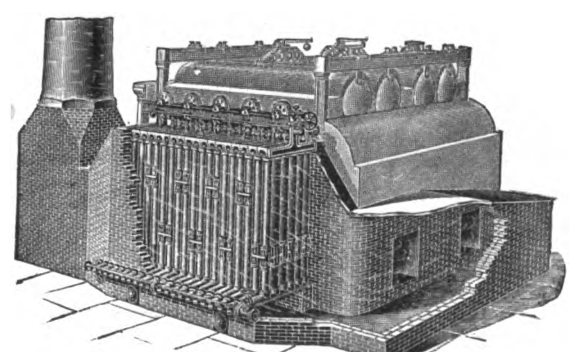

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